This is a digital copy of a book that was preserved for generations on library shelves before it was carefully scanned by Google as part of a project to make the world's books discoverable online.

It has survived long enough for the copyright to expire and the book to enter the public domain. A public domain book is one that was never subject to copyright or whose legal copyright term has expired. Whether a book is in the public domain may vary country to country. Public domain books are our gateways to the past, representing a wealth of history, culture and knowledge that's often difficult to discover.

Marks, notations and other marginalia present in the original volume will appear in this file - a reminder of this book's long journey from the publisher to a library and finally to you.

Usage guidelines

Google is proud to partner with libraries to digitize public domain materials and make them widely accessible. Public domain books belong to the public and we are merely their custodians. Nevertheless, this work is expensive, so in order to keep providing this resource, we have taken steps to prevent abuse by commercial parties, including placing technical restrictions on automated querying.

We also ask that you:

+ *Make non-commercial use of the files* We designed Google Book Search for use by individuals, and we request that you use these files for personal, non-commercial purposes.
+ *Refrain from automated querying* Do not send automated queries of any sort to Google's system: If you are conducting research on machine translation, optical character recognition or other areas where access to a large amount of text is helpful, please contact us. We encourage the use of public domain materials for these purposes and may be able to help.
+ *Maintain attribution* The Google "watermark" you see on each file is essential for informing people about this project and helping them find additional materials through Google Book Search. Please do not remove it.
+ *Keep it legal* Whatever your use, remember that you are responsible for ensuring that what you are doing is legal. Do not assume that just because we believe a book is in the public domain for users in the United States, that the work is also in the public domain for users in other countries. Whether a book is still in copyright varies from country to country, and we can't offer guidance on whether any specific use of any specific book is allowed. Please do not assume that a book's appearance in Google Book Search means it can be used in any manner anywhere in the world. Copyright infringement liability can be quite severe.

About Google Book Search

Google's mission is to organize the world's information and to make it universally accessible and useful. Google Book Search helps readers discover the world's books while helping authors and publishers reach new audiences. You can search through the full text of this book on the web at `http://books.google.com/`

Y 4. M31/2: M56

THE METRIC SYSTEM

HEARINGS

BEFORE A

SUBCOMMITTEE OF THE COMMITTEE ON MANUFACTURES UNITED STATES SENATE

SIXTY-SEVENTH CONGRESS

FIRST AND SECOND SESSIONS

ON

S. 2267

A BILL TO FIX THE METRIC SYSTEM OF WEIGHTS AND MEASURES AS THE SINGLE STANDARD OF WEIGHTS AND MEASURES FOR CERTAIN USES

Printed for the use of the Committee on Manufactures

WASHINGTON
GOVERNMENT PRINTING OFFICE
71941 1922

COMMITTEE ON MANUFACTURES.

ROBERT M. LA FOLLETTE, Wisconsin, *Chairman.*

WILLIAM S. KENYON, Iowa.
BERT M. FERNALD, Maine.
CHARLES L. McNARY, Oregon.
WILLIAM B. McKINLEY, Illinois.
SAMUEL D. NICHOLSON, Colorado.
OVINGTON E. WELLER, Maryland.

ELLISON D. SMITH, South Carolina.
ATLEE POMERENE, Ohio.
ANDRIEUS A. JONES, New Mexico.
JAMES A. REED, Missouri.

ROBERT M. LA FOLLETTE, JR., *Clerk.*

THE METRIC SYSTEM.

TUESDAY, OCTOBER 11, 1921.

UNITED STATES SENATE,
SUBCOMMITTEE OF THE COMMITTEE ON MANUFACTURES,
Washington, D. C.

The subcommittee met, pursuant to call, at 11 o'clock, a. m., in the room of the Committee on Manufactures, United States Capitol, Senator Charles L. McNary presiding.

Present: Senators McNary (chairman) and Jones of New Mexico.

The subcommittee had under consideration the bill S. 2267, which is here printed in full, as follows:

[S. 2267, Sixty-seventh Congress, First Session.]

"A BILL To fix the metric system of weights and measures as the single standard of weights and measures for certain uses.

"*Be it enacted by the Senate and House of Representatives of the United States of America in Congress assembled*, That from and after ten years from the date of passage and approval of this act the weights and measures of the meter-liter-gram or metric system shall be the single standard of weights and measures in the United States of America for the uses set out herein.

"SEC. 2. That the national prototypes of the fundamental standards of the metric system shall be the copies of the standards known as meter numbered twenty-seven and kilogram numbered twenty, allotted to the United States by the General Conference of Weights and Measures held at Paris in 1889. These are now deposited in the vault of the Bureau of Standards of the Department of Commerce and are those which are now used and employed in deriving the values of all weights and measures used in the United States. These national representations are hereby adopted as the primary standards of weights and measures for the United States of America, and from these all other weights and measures shall be derived and ascertained.

"SEC. 3. That from and after ten years from the date of passage and approval of this act no person shall do or offer or attempt to do any of the following acts, by weights or measures, in or according to any other system than the metirc system of weights and measures, namely:

"(1) Sell any goods, wares, or merchandise except for export, as provided in section 8;

"(2) Charge or collect for the carriage or transportation of any goods, wares, or merchandise.

"SEC. 4. That from and after ten years from the date of passage of this act no person shall use or attempt to use in any of the transactions detailed in section 3 any weight or measure or weighing or measuring device designed, constructed, marked, or graduated in any other system than the metric system of weights and measures.

"SEC. 5. That not later than ten years from the date of passage and approval of this act all postage, excises, duties, and customs charged or collected by weights or measures by the Government of the United States shall be charged or collected in or according to the metric system of weights and measures.

"SEC. 6. That rules and regulations for the enforcement of this act not inconsistent with the provisions hereof shall be made and promulgated by the Secretary of Commerce. The Secretary of Commerce shall also take such steps as he may deem expedient for giving publicity to the dates of transition specified herein and for facilitating the transition to the meter-liter-gram or metric system.

"SEC. 7. That all acts or parts of acts inconsistent herewith are hereby repealed but only in so far as they are inconsistent herewith; otherwise they shall remain and continue in full force and effect. Whenever in any act, or rules and regulations, or tariff or schedule made, ratified, approved, or revised by the Government of the United States of America weights or measures of the system now in customary use are employed or referred to, and to comply with the provisions of this act weights and measures of the metric system should be employed, then such references in such act, rules and regulations, tariff, or schedule shall be understood and construed as

63 529SU XL 1931
12/00 31150-37

references to equivalent weights or measures of the metric system ascertained in accordance with the required degree of accuracy.

"SEC. 8. That nothing in this act shall be understood or construed as applying to—

"(1) Any contract made before the date at which the provisions of this act take effect;

"(2) The construction or use in the arts, manufacture, or industry of any specification or drawing, tool, machine, or other appliance or implement designed, constructed, or graduated in any desired system;

"(3) Goods, wares, or merchandise intended for sale in any foreign country, but if such goods, wares, or merchandise are eventually sold for domestic use or consumption then this clause shall not exempt them from the application of any of the provisions of this act.

"SEC. 9. That nothing herein shall be understood or construed as prohibiting the enactment or enforcement of weights and measures' laws or ordinances by the various States or cities, and the various States or cities shall have the same powers as though this act were not in force and effect: *Provided, however*, That no standard weights or measures shall be established for the uses set out herein which conflict in any way with the standards established herein, and such standards which may already have been established shall be null and void for the uses set out herein.

"SEC. 10. That the word 'person' as used in this act shall be construed to import both the plural and singular, as the case demands, and shall include corporations, companies, societies, and associations. When construing and enforcing the provisions of this act, the act, omission, or failure of any officer, agent, or other person acting for or employed by any corporation, company, society, or association, within the scope of his employment or office, shall in every case be also deemed to the act, omission, or failure of such corporation, company, society, or association as well as that of the person."

The CHAIRMAN. The subcommittee will come to order. We are ready to proceed, gentlemen.

STATEMENT OF MR. THEODORE H. MILLER, WORKS MANAGER THE DE LAVEL SEPARATOR CO., POUGHKEEPSIE, N. Y.

The CHAIRMAN. Kindly state your name and occupation.

Mr. MILLER. Theodore H. Miller, works manager the De Lavel Separator Co., Poughkeepsie, N. Y.

I have no fixed or prepared statement. I thought this would be an informal hearing and I presume it is.

The CHAIRMAN. Certainly.

Mr. MILLER. I came here to testify as one who has had many years of experience in manufacturing machinery. I had manufactured during all my business career under the English system until we later changed to the metric. Our method of production was changed to the metric basis some 12 or 15 years ago; I can not tell exactly when.

My purpose in making this statement is to give you the testimony of one who has had actual experience with both of these systems.

The CHAIRMAN. Where is your factory located?

Mr. MILLER. At Poughkeepsie, N. Y.

The CHAIRMAN. Do you sell a portion of your manufactured products abroad?

Mr. MILLER. None of them, except some in Canada.

I want to stress the point about the little or no cost to change over a manufacturing establishment from the English to the metric system. With us this is not theorizing, this is not an academic discussion; we have done it. We have a very complete and efficient system of cost accounting. The cost of changing over to this system can not be found in the product.

The CHAIRMAN. Gentlemen, when this hearing was set for to-day it was not known that there would be the situation which exists on the floor of the Senate this morning. I am compelled to be there for a while, and I will ask your indulgence. We will take a recess until 12 o'clock.

(At the conclusion of an informal recess the hearing proceeded.)

The CHAIRMAN. Proceed, Mr. Miller.

Mr. MILLER. To continue what I was saying, as a start we simply changed the figures on the drawings and gauges most constantly in use. I want to emphasize the fact that we changed the size of nothing. The opponents of the metric system continually harp on the statement that with the introduction of the metric system it is necessary to scrap and throw away and change everything in connection with manufacture. I speak of manufacture particularly, because my experience has been with manufacture; but I will digress to say that mountains and trees, distances and weights, will all be exactly the same—we will only express them in a more simple method.

There is a relation between length and width. Manufacture of course is based on engineering and mathematics and mathematics are naturally and inherently decimal; they can not be anything else. So that the cost of changing over our manufacturing process from the basis of the English system to that of the metric system was practically nothing; it could not be found.

We changed nothing. Even now when we design new machinery, as we constantly do, and are called on to do, we very frequently use the sizes that many years ago originated in English. We just express them in another manner. The sizes have been found correct and well adapted to their purpose. We simply express them in the metric system because it is more simple and less liable to error than the English. And it is less liable to error for the same reason that you are liable to be more accurate in making figures, in adding up money, for instance, in our own monetary system than you would in pounds, shillings and pence.

The statement is very frequently brought out in connection with manufacturing, as I said before, that if this were imposed upon the manufacturers of this country it would be necessary that they throw away—not change, but throw away—all of their drawings, all of their gauges and most of their machinery.

Can you imagine anything more absurd than throwing away a pattern for an iron casting which pattern has no dimensions on it at all, if it has nothing but distinguishing numbers, and throwing this pattern away and scrapping it, just because it is to be machined later to the metric system? It will be machined to the exact same size it was before, but you call it something else which is more simple.

Senator JONES. Let me ask you a question right there. Would you have any difficulty, by reason of the use of decimals in the metric system, to express accurately present dimensions? For instance, take a screw that is seven-eighths of an inch in diameter. How would you express that in the metric system? How would it work out?

Mr. MILLER. If you called a screw "seven-eighths" you could not express it in even figures, because seven-eighths is not an even figure either; it is a fraction. If you want to get down accurately to seven-eighths in machine-shop practice—that is what I refer to because of my experience—if you mean a really accurate screw, you will give it in thousandths of an inch, a point and three places. If you wish to express that in the metric system, you can do it still more accurately with a point and two places, millimeters. In other words, you save one place. In making calculations and figures and figures on drawings you have the decimal and two places, which gives you one-hundredth of a millimeter. The corresponding thing in the English system is a point and three places, corresponding to thousandths of an inch.

Senator JONES. I asked my question in respect to what you were just stating.

Mr. MILLER. Yes.

Senator JONES. That there would be no difficulty in handling materials of present dimensions.

Mr. MILLER. No.

Senator JONES. But just simply expressing them in different terms.

Mr. MILLER. I understand your question perfectly.

Senator JONES. And I would like to know how you would express the seven-eighths. I must confess a very large degree of ignorance on this entire subject, and I am seeking information.

Mr. MILLER. You see, I can not tell you out of my head what it would be.

Mr. SCHIEFFELIN. There it is [indicating].

Mr. MILLER. Yes; 22.22. This is millimeters; it gives 22.22.

Senator JONES. Is that absolutely complete? Is the measurement in millimeters identical with the seven-eighths of an inch in our present system?

Mr. MILLER. It is nearer than the finest gauges can be made.

Senator JONES. I see.

Mr. MILLER. As I started to tell you, you take one-hundredth of a millimeter, and it takes two and a half of those to make one one-thousandth of an inch, by which I mean to say that by using two decimal places in the metric system you get an accuracy much finer and closer than you do with three places in the English. That is due merely to the fact that in one case you are dealing with a millimeter or a smaller unit.

There [indicating a metal rule] is something that will help you visualize the metric system. I think that would be a good thing for you to have, if you will keep it.

Senator JONES. I thank you very much for it; I will be delighted to do so.

Mr. MILLER. You see, this is a good portion of the metric system itself. This steel scale is 10 centimeters. It is a tenth of a meter long or 10 centimeters. You can call it 10 cents, if you want to. It resembles our monetary system. Its width is one-tenth of its length. It is 1 centimeter wide. Its thickness is one-tenth of its width or one-hundredth of its length. It is 1 millimeter thick. You see its cubical con-

tents is 1 milliliter. Its weight is the specific gravity, because it is all connected up by the weight of water, the standard specific gravity. You see how nicely this connects up. How much does a gallon of water weigh, do you know? I don't. I could find out.

Senator JONES. No; I do not believe I know accurately.

Mr. MILLER. If you take a 10 centimeter cube of distilled water it weighs 1 kilogram, and 1,000 of those, a cubic meter, weighs 1 ton. You see how simple it all is. The length and the width are all hooked up together. It is easier to work with this simple system than to remember how many feet are in a mile—5,280. That is a land mile. A marine mile, or a knot, is something longer. I don't remember what that is, but, anyway, there are two kinds of miles, just as there are two kinds of tons.

In this system you can do all these problems in your head, because there are just 1,000 meters in a kilometer. And after all we use this system quite a good deal, for who has not heard of the kilowatt—1,000 watts? We all use it now. We use it in our money system. Would anybody say there is less accuracy in accounting, in money, because of the danger of misplacing a decimal point? And that is the charge that is brought against the metric system. Would anybody in this country seriously consider going to the English system of pounds, shillings, and pence because it was more accurate or simple? Not for a moment. It is simplicity itself, and the whole thing is tied together, volume and length and weight; it is all one thing.

We have in our factory a highly specialized product. It is not a jobbing shop. It is a manufacturing place where we have had as high as 1,700 people, and we do not hear of any difficulties. There are no difficulties. Anyone who has the intelligence to work in a plant, and hold a job there, can learn all that he needs to know about the metric system, as applied to the work he is doing, in 30 minutes. And there is no necessity of throwing away anything.

The charge is made that if this system were adopted it would cost the manufacturers of this country some millions of dollars to replace drawings and gauges and patterns none of which need to be thrown away. It won't cost them anything; or, anyway, the cost will be so small that, like ourselves, they will never be able to find the cost. And it is our experience and our belief that the slight cost there is will be more than paid in the very first year of operation.

I believe that there should be some provision, just as there is in this bill, to permit the manufacturers to go on using their present systems if they please within their own shops.

Senator JONES. The passage of this bill would make it necessary, would it not, to alter all of the scales of the country?

Mr. MILLER. I think it would.

Senator JONES. And the yardstick?

Mr. MILLER. Yes; I think so.

Senator JONES. And the surveyor's measuring instruments?

Mr. MILLER. Only his staff and his chain; not the instrument itself. The inconsequentials would have to be changed. Of course he could use those, you know. He could use his conversion table just the same as I have in my pocket and always have a steel tape. It is English on one side and metric on the other. If somebody asked me what is a foot, I can not tell exactly, but I can turn around here and tell them, because I have got it right here.

But you know this conversion, this trying to visualize what it would be in something else, is a great mistake. I suppose all of you know that the way to learn some other language is not to think what this thing is in your own language. In fact, if you had a good teacher, the teacher would not permit that at all. They just point to these things and say, "This is so and so."

Senator JONES. In other words, you want to get the thing in the new language.

Mr. MILLER. If somebody tells you that something is 10 centimeters long or a meter long, don't waste any time thinking how long that is in English; just look at what that is, and in an astonishingly short time you have that new vision, and you don't try to think what it is.

When you go to England the best thing you can do is just to spend a little time in trying to comprehend their money system, and just never mind what it was in American currency—forget about it. Because just so long as you try to work in equivalents you will be up in the air and you won't get anywhere.

As I said before, I think it is a wise provision in this bill to allow manufacturers and others to use the system they have, because you see it will be a hardship on the mentally aged, people who are just so constituted that they can not accept new things. After they have sold goods and listed them a while under a decimal system they will very quickly find out and voluntarily go to the other, without being forced to do it.

I think I have about finished. The only thing I wish to stress——

Senator JONES. I was not here when you began.

Mr. MILLER. Well, there was very little went on. I just barely got started when a recess was taken. The only thing I wish to stress is the fact that in the machinery manufacturing business there are no difficulties and practically no expense to the change; but, on the other hand, there are many advantages. Nearly all of the tool manufacturers in this country—I will amend that by saying all who make tools, and many of them who make other parts, list their tools in either English or metric dimensions at the same price, and they simply have been stampeded to the idea that unless they contribute to this campaign their plants are going to be turned upside down and they will be put to heavy expense. And their opposition I think is not based upon what they think is good for the general public and for ourselves internationally.

Senator JONES. If you have not done so I wish you would tell us to what extent this movement is being advocated; who are its advocates, and why?

Mr. MILLER. I can not tell you that. We took it up——

Senator JONES. You say "we." Who are "we"?

Mr. MILLER. This corporation with which I am connected, the De Lavel Separator Co., which is a manufacturing concern. I do not represent any committee at all; I just represent myself and our company. Our corporation took it up because of its great simplicity and its lack of error, and because we believed that we must eventually fall in line with the rest of the world, anyway.

Senator JONES. I was coming to that. To what extent has the rest of the world adopted this system? It may be that some one else is here who wants to present that side of the case. If so I will not ask these questions.

Mr. MILLER. So far as I know, to the best of my belief, to answer your question, ourselves and England are the only ones who have not.

Senator JONES. You say "ourselves."

Mr. MILLER. I mean this country and, say, the British Empire. If you will excuse me, I have not tried to go into this question extensively, because I know there is plenty of material published on it.

The CHAIRMAN. The mathematics is not so important. We have that in printed literature. What we want is its practical application.

Mr. MILLER. You want to know something from somebody who has had experience.

The CHAIRMAN. That is it; the practical application of the thing. We can not undertake to study it as an academic question.

Mr. MILLER. I thought you wished to hear from some one who had some years of experience in the practical use of this system.

The CHAIRMAN. That is it.

Mr. MILLER. And that is what I came here to testify about.

The CHAIRMAN. We are obliged to you for coming. Had you finished what you wanted to say?

Mr. MILLER. I think so. I wish you would look at that little scale [indicating]. Keep it.

The CHAIRMAN. Thank you.

Mr. MILLER. It is about the most comprehensive thing in a small way that I ever saw. I have here a very short statement, just a page, that I had prepared, on this subject; also copies of letters to Mr. W. Mortimer Crocker from Carl E. Schmidt & Co. and the Graham Roller Bearing Corporation, respectively, which I would like to incorporate in the record as part of my statement.

The CHAIRMAN. Without objection that may be done.

(The papers referred to are as follows:)

POUGHKEEPSIE, N. Y., *September 15, 1921.*

I have been works manager of the De Laval Separator Co. since 1903. We have had as many as 1,700 employees during our busiest periods and just now have 600. About 1910 we changed to the general use of the metric system throughout our plant. Before doing so, we were repeatedly warned that the change would involve great expense; this, however, was not the case.

We run a highly specialized industry, and the advantages gained by the use of so simple a system as the metric, have been worth to us more than ten times the slight initial cost required to make the change. This cost consisted merely in the purchase of a few small tools and the changing of figures on drawings and gauges. It will be appreciated that no change in the actual size of anything was required, merely the expression of sizes in a more convenient measure. By placing on our drawings the expression "All dimensions in millimeters," we follow the practice recommended by the American Metric Association, and avoid the necessity of placing even the familiar abbreviation mm. after figures.

We have from time to time engaged a large number of new employees, and these have not had the slightest difficulty in acquiring, within a day or so, everything that needed to be understood about the metric system.

I have read carefully the metric bill, H. R. 10, now before the House, and the corresponding bill, S. 2267, before the United States Senate. I believe that the period of 10 years allowed for the change to the metric system is ample time; that the bill is satisfactory and should be passed, not alone in the interest of the American public but in the interest of American manufacturers.

THEO. H. MILLER.

CARL E. SCHMIDT & CO. (INC.),
Detroit, Mich., January 7, 1921.

Mr. W. MORTIMER CROCKER,
Congress Hall Hotel, Washington, D. C.

DEAR SIR: Your favor of January 5 at hand. The metric system is principally used in our dyeing department, and has unquestionably eliminated a great many errors. In fact, it has demonstrated its efficiency to such an extent that we would not consider for a moment returning to the English standard.

Personally, the writer is of the opinion that all scales should bear the metric and English measures during a transition period so that the public would familiarize themselves with the equivalent.

Regarding the estimated cost, I can not comprehend any such figures as some of the advocates of the present system present. As far as we are concerned, if the Congress were to make the metric system the only legal system to-morrow, we would merely change our graduations on the beams to fit the less complicated system.

Very truly, yours,

CARL E. SCHMIDT & CO. (INC.),
By N. J. SCHORN.

COUDERSPORT, PA., *January 10, 1921.*

Mr. W. MORTIMER CROCKER,
Congress Hall Hotel, Washington, D. C.

DEAR SIR: Replying to your favor of January 5, regarding the metric system, we are pleased to answer your questions as follows:

1. We use the metric system entirely for all our bearings, even figuring the diameter of our rolls in millimeters. We also use the metric system for all calculations, after arriving at the final result, transposing the answer into inches.

2. We certainly favor the gradual adoption of metric standardization of weights and measures in the United States, and will do all in our power to further same.

3. It is impossible for the writer to believe that the cost of changing would be very great for the reason that at the start dimensions could be given in millimeters and decimals, holding to the present sizes and dimensions of parts and material. It would be the easiest thing in the world to gradually change to metric dimensions as time went on, and we find that there are practically no dimensions used to-day in even inches where any accuracy is required, but that all dimensions resolve themselves into inches and fractions, usually thousandths of an inch. This can just as well be given in millimeters as in inches.

It would, of course, mean some very careful, earnest work to be done by the engineering department of the various factories, but as far as the factory itself is concerned we believe that the change could be made with almost no break whatever.

Very truly, yours,

GRAHAM ROLLER BEARING CORP.
D. H. GRAHAM, *Sales Engineer.*

STATEMENT OF DR. WILLIAM JAY SCHIEFFELIN, CHEMIST, NEW YORK CITY.

The CHAIRMAN. State your name, address, and occupation.

Mr. SCHIEFFELIN. William Jay Schieffelin; I am a chemist, of New York.

The CHAIRMAN. How long have you been in that line of business in New York?

Mr. SCHIEFFELIN. I personally have been in it since 1889, but the concern of which I am president was established by my great-great-grandfather in 1794. And as bearing on this discussion the old bills that we have, for 10 years after the concern was started, were in pounds, shillings, and pence. And it took a certain amount of time to get the business community to take up the decimal currency.

The CHAIRMAN. What is the extent and nature of your business?

Mr. SCHIEFFELIN. It is a wholesale drug business and laboratory, manufacturing *medicinal chemicals* and pharmaceuticals.

The CHAIRMAN. For the benefit of the record, how extensively do you operate?

Mr. SCHIEFFELIN. We employ about 300 people and have customers all over the country.

The CHAIRMAN. How about foreign countries?

Mr. SCHIEFFELIN. Only to a limited extent.

The CHAIRMAN. Do you have any foreign lines?

Mr. SCHIEFFELIN. Oh, yes; any drug business has to import.

The CHAIRMAN. I merely want the record to show.

Mr. SCHIEFFELIN. Yes, sir; we import and export to a certain extent.

The CHAIRMAN. What experience have you had in an educational way?

Mr. SCHIEFFELIN. I studied chemistry at the School of Mines, in Columbia University, New York, graduating in 1887. Then I studied abroad in Munich and got a degree of doctor of philosophy. It was in Munich that I became entirely accustomed to the use of the metric system, although, of course, in the laboratory at Columbia we used it. In Munich it was used all over. I lived there a year and a half, and when I came back I was really shocked to find the complication and the delay, not only in business but in ordinary life, that this present lack of system entails upon us. It is a greater handicap than any of us appreciate.

Educators have told me that every child in America wastes two years in school covering the subject of higher mathematics, due to the confusion occasioned by the present system, particularly the denominate numbers, which if it could be wiped out would make mathematics much easier, because they do not have to puzzle their heads about remembering all of these absurd ratios and endless confusing tables.

In our own laboratory we have had experience with both systems, or at least with the metric system and the Latin system—what is called the avoirdupois and the apothecary measures. You know that to-day the retail druggist buys his drugs and chemicals by the avoirdupois weight and sells them on prescription by the apothecary weight. Nothing could be more stupid.

And there is the time it takes. I have had the thing checked up and we estimate that in our chemical work it would save five clerks out of seven in the buying, the billing, the calculating, the invoices. Of course, we figured having goods packed in hundreds and in tens, rather than in dozens and in gross. That is a very absurd system. When you buy by the gross you can not tell what it will cost without a mental strain. When you buy by the hundred you know immediately what the cost will be without any strain whatever.

I had my laboratory people make practical experiments, both in writing and in weighing, in figuring on the formulæ and calculating the figures, and so on, and if I may I would like to put in the record, as a part of my statement, the results of those experiments.

The CHAIRMAN. That may be done.

Mr. SCHIEFFELIN. Attached to that paper is an article entitled "Progress toward adoption of the metric system," written by myself and published in the New York Commercial, which might as well go in, if you have no objection.

The CHAIRMAN. Very well.

(The paper referred to is as follows:)

PROGRESS TOWARD ADOPTION OF THE METRIC SYSTEM.

Everyone admits that there would be a great advantage in a universal system of weights and measures. It is only a question of time when the United States and Great Britain will swing into line with the other nations of the world to adopt a simple system.

Congressman Britten and Senator Ladd, who is a trained chemist, have introduced a measure which, if it is adopted, will place this country on a decimal basis without undue confusion. The bill provides that after 10 years the meter-liter-gram or metric system shall be the single standard of weights and measures in the United States as far as the sale or transportation of goods, wares, or merchandise is concerned. It is necessary that this reform should be brought about by law because experience in other lands teaches that the only way to secure general adoption is to make it obligatory after a reasonable time. During the 10 years there should be a campaign of education to bring in the new system gradually and surely. Medical and pharmaceutical teachers should use the metric system in their lectures and textbooks (placing the old equivalents in parentheses), and druggists should all provide themselves with metric weights. The absurdity of a retail druggist buying by avoirdupois ounces and selling by apothecary's ounces would be forever ended.

That the wholesale druggist would be benefited by the change can not be denied. The time to invoice and extend charges in grains, ounces, and pounds, pints, quarts, and gallons, would be reduced *fully 50 per cent* if the simple decimal system were adopted. The *probability of error in calculations* would also in like measure be reduced.

After a few years we would all think a proposal to return to the present lack of system would be as ridiculous as a suggestion that we change our monetary system from dollars and cents back to pounds, shillings, and pence.

Obviously, our foreign trade will be stimulated, our transactions with Europe, South America, China, and Japan will be simplified, and England will surely follow our example, if she does not beat us to it, because the decimal movement in Great Britain is assuming large proportions.

Therefore, every chemist, druggist, physician, and merchant should advocate the passage of the Britten bill—which bears the appropriate number 10.

THE ADOPTION OF THE DECIMAL SYSTEM A DUTY.

[Paper presented by Dr. William Jay Schieffelin, president Schieffelin & Co., at the convention of the American Metric Association, held in the United Engineering Building, New York City, Dec. 27, 1919.]

When one considers the proposal to replace our complicated series of weights and measures by the metric system, there are three phases of impressions received, which develop interest, convince the mind, and finally enlist the heart. First, it appears to be scientifically true; a proposal theoretically correct and desirable if we were beginning over again; then it is seen to be practical and economical; a means of saving much time and money; finally, one realizes the moral wrong to children, to workers, to everyone at home and to our neighbors, and then the demand for reform becomes a crusade.

That the arguments in favor of the decimal system have already received wide circulation and have proved convincing, is shown by an incident recently reported. A prominent debating society considered the topic, "*Resolved*, That the metric system should be adopted in this country," but had to withdraw it as being so one-sided that it was manifestly unfair to ask any team to take the negative. In fact, it was stated that there were no arguments whatever against the proposition. Granting, therefore, that it is desirable, we should appraise its desirability and also the obstacles to be overcome before it is adopted. The children are all for it. They appreciate that it would save them at least one and probably two years of schooling, or rather give them time in school for attaining the scientific knowledge which now has to be crowded out by the absurd mass called denominate numbers. The business men are not for it until it is explained to them, and when it can be shown that 7 clerks could do the work under the decimal system, which now requires 12, they begin to take notice, because in every step in the intricate process of business in buying, in calculating the formulas, in calculating costs, in taking inventories, in billing, the time required in making the extensions is nearly double (much more than double in the case of a beginner) than if everything were done under the simple decimal system.

Already some manufacturers of individual articles, which are sold by count, have adopted the decimal system. The manufacturers of rubber goods put them up in tens and in hundreds; the manufacturers of corks put them up in thousands.

At the convention held last February by representative buyers of sundry articles sold by druggists it was unanimously voted that the manufacturers of tooth brushes and all such articles be requested to put them up in tens and hundreds instead of by the gross. When you know the price of 100 you instantly know the price of 1, whereas you have to make a calculation when you get the price by the gross. In manufacturing operations the saving in time and the reduction in losses due to inaccuracy also amounts to from 40 to 60 per cent. The following examples of work done in a manufacturing pharamaceutical laboratory illustrate this:

THE METRIC SYSTEM.

An estimate of the possible saving in time by using the metric system in place of pounds, ounces, and grains with special reference to the drug business is appended.

(A) *Writing*.—In writing the amounts no time is saved if the figures are whole numbers or in decimal fractions.

Example 1:

5.5 pounds=2.5 kilograms.
7.75 pounds=3.52 kilograms.
22 pounds=10 kilograms.

But if the amounts are in pounds and ounces, or also grains, then the metric system requires less than half as much time.

Example 2:

1 lb. 3 oz. 237 gr., 14 characters.
554 gm., 5 characters.

Example 3:

13 lb. 12 oz. 311 gr., 16 characters.
6.256 kg., 7 characters.

Example 4:

5 lb. 9 oz., 8 characters.

2.523 gm., 6 characters.

The error factor is very much less for the metric amounts because of the less number of figures to be written and the ease of checking the figures are written.

Since most pharmaceutical formulae are calculated to grains per unit of 1 teaspoonful, 1 fluid ounce or one tablet or pill, each amount of each ingredient must be calculated to pounds, ounces, and grains or pints, fluid ounces, and minims.

In instances of this kind the metric system means a saving of 50 to 75 per cent in the time of the actual writing.

(B) *Weighing.*—In the act of weighing the time ratio using block weights is somewhat similar to the writing.

Example 5:

1 pound 3 ounces 237 grains avoirdupois—1-pound weight, 2-ounce weight, 1-ounce weight, 120-grain weight, 60-grain weight, 30-grain weight, 20-grain weight, 5-grain weight, 2-grain weight; total, 9 weights used.

554 grams—500-gram weight, 50-gram weight, 2-gram weight, 2-gram weight; total, 4 weights used.

Example 6:

13 pounds 12 ounces 311 grains—10-pound weight, 2-pound weight, 1-pound weight, 8-ounce weight, 4-ounce weight, 240 grain weight, 60-grain weight, 10-grain weight, 1-grain weight; total, 9 weights required.

6.256 kilograms—5-kilogram weight, 1-kilogram weight, 200-gram weight, 50-gram weight, 5-gram weight, 1-gram weight; total, 6 weights required.

The weight in pounds, ounces, and grains will usually require more time because of the number of weights to be handled and also the possibility of error is greater since more mental calculations in addition are necessary.

(C) *Calculating.*—The simplicity of the metric system is self-evident in calculating from one unit to some higher number.

Example 7:

$\frac{1}{4}$ grain to 10,000 times.

0.016 gram to 10,000 times.

$10{,}000 \times \frac{1}{4} = 2{,}500$ grains.

2,500÷437.5 grains=5 ounces 312.5 grains.

```
437.5)2,500.0(5 ounces.
      2,187.5
      -------
        312.5
```

$0.016 \times 10{,}000 = 160$ grams.

The first calculation requires the writing of 44 characters while the latter requires only 18 characters.

Example 8:

$1\frac{1}{2}$ grains to 36,000 times.

0.096 gram to 36,000 times.

```
      36,000
          1½
      ------
      36,000
      18,000
      ------
7,000)54,000(7 pounds 5,000 grains.
      49,000
       5,000
437.5)5,000(11 ounces
      4,375
      -----
       6,250
       4,375
       -----
       1,875
```

7 pounds 11 ounces 187.5 grains.

```
      0.096
       36,000
      -------
       576,000
      288
      -------
```

3,456,000 grams, or 3.456 kilograms.

The first calculation requires the writing of 89 characters, while the latter requires only 38 characters.

Example 9:

¼ gr. in 1 fl. dr. to 5 gallons.
0.016 gm. in 4 mils to 20 liters.

```
  128 fl. oz. in 1 gallon
    5
  ----
  640 fl. oz. in 5 gallons
    8
  ----
5,120 fl. dr. in 5 gallons÷4=1,280 grams.

437.5)12,800(2 ounces
      8,750
      -----
      4,050
```

20 liters or 20,000 mils÷4=5,000 mils.
4 mil quantities ×0.016 gm.=80 gm.

The first calculation requires the writing of 90 characters, while the latter only requires 56.

(D) *Calculating increase.*—Increasing the quantity of a formula shows like results.

Example 10:

7 lb. 11 oz. 187.5 gr. to 8 times the quantity.
3.499 kg. to 8 times the quantity.

```
 7 lb.          11 oz.          187.5 gr.
 8              8                  8
 --             --              -----
 56             88              437.5)15,000 gr.(3 oz.
  5              3                    13,125
 --             --                    ------
 61 lb.         16)91(5 lb.            187.5 gr.
                   80
                   --
                   11 oz.
```

61 lb. 11 oz. 187.5 gr.

```
  3,499 kgs
      8
  -------
  27.992 kg.
```

The first calculation requires the writing of 76 characters, while the latter requires only 16.

(E) *Pricing.*—

Example 11:

7 pounds 11 ounces 187.5 grains, at $7.75 per pound.
3.499 kilograms, at $17.09 per kilogram.

```
187.5 grains÷7,000=     0. 0268 pound.
11 ounces÷16      =     0. 6875 pound.
                        7.      pounds
                        -------
                        7. 7143 pounds
                         $7. 75
                        -------
                        385715
                       540001
                      540001
                     ---------
                     $59. 785825

                        3. 499 kilograms
                       $17. 09
                        31491
                       24493
                      3499
                     ---------
                     $59. 79791
```

The first calculation requires the writing of 86 characters, while the latter requires only 36.

Summary.—With the metric system there is a possible saving of time in:

(A) Writing, about 50 per cent.
(B) Weighing, about 45 per cent.
(C) Calculating original formulæ, about 50 per cent.
(D) Calculating increase in original formulæ, about 80 per cent.
(E) Pricing, about 55 per cent.

Average, 56 per cent.

By reason of the calculations usually being simpler and the number of calculations less in number to arrive at the same result, the error factor is reduced even greater than the time saving.

Finally, we are not only handicapping ourselves in our trade with the rest of the world, but are actually injuring our neighbors by clinging to our complicated weights and measures. The reports recently published on the extent to which the metric system has been adopted in South American countries show clearly that the greatest hindrance to the full adoption of the metric system is the fact that their goods received from England and the United States are measured in yards or gallons or pounds.

If we are too slothful to make the change for our own good, a decent respect for the opinion of mankind should decide us to do it for the good of mankind.

WM. JAY SCHIEFFELIN.

DECEMBER 27, 1919.

[From Pacific Ports, September, 1921.]

IN THE OPINION OF THE PRESS.

Progressive firms the world over who are doing an international business are agitating and clamoring for a system of standardized and efficient weights and measures, says the Dutch East Indian Archipelago (Buitenzorg, Java), which discusses the matter at length as follows:

"*Systems cumbersome.*

"The varied systems now in use are not only cumbersome, inefficient, and troublesome, but conspicuous for the lack of logic displayed. The clerk hire, the misunderstandings, and mistakes incurred in converting piculs to tons, liters to quarts, gallons and bushels, inches and feet to meters, etc., is useless, unnecessary, and ridiculous. On the surface this may not appear to be of much serious consequence, but anyone who has attempted to harmonize the finer measurements of nuts, bolts, screw threads, and machine parts under the present system will soon realize the seriousness and inconvenience of our lack of international standards.

"The decimal coinage system has long since proved its superiority over the cumbersome pound, shilling, and pence method which is so burdensome to countries doing business with England, but this is not nearly as ridiculous as some of the weights and measures which could be far more easily converted to the simple and sane metric system. International business, as it flows along in a steady stream, as a great river in a well-defined course, is not easily changed or dammed long enough to make even the slightest change. However, the ideal of standardization is not an idle dream, but a real possibility once the conservatives can be overthrown by the father sighted, progressive, public-spirited trader.

"Before much can be done to establish an international harmony in our weights and measurement systems a great deal of ground must be covered toward the standardization of local systems in various countries. The United States can boast of at least a score of varieties of bushels, China of a good collection of different dollars and cents, the East of a various assortment of piculs, etc.

"Undoubtedly there are a great many difficulties to be encountered before even the most minor changes along this line can be realized, but the fact remains that the world is thinking in international terms as it never has before. Narrow provincialism is giving away to the broader world vision, and the countries of the world are sincerely striving to get on a better basis of understanding as never before. Perhaps the time is far distant when a universal language will be in common business use throughout the world and the idea of an international monetary standard may be an idle dream, but a common standard of weights and measures for the business world is not only practical, efficient, and logical, but a possibility. With all of our modern efforts toward speed and efficiency it is rather a travesty on the common sense of the business world to be still clinging to the present motley assortment of systems for weights and measures."

Mr. SCHIEFFELIN. By not adopting the metric system we are only handicapping ourselves and we are really being unneighborly to the rest of the world. There was a survey made of South American countries, within three years, and they all reported that they were officially using the metric system, and it would be universally used if it was not for the fact that their trade with England and with the United States required them to deal in yards and in pounds. It is too bad when other people are trying to be saving that we should handicap them by this foolish system.

Mention was made of the time that it would take to do this. I am informed that in Sweden they enacted a similar act; that at the end of 10 years the metric system was to be in force and the only system in force. Then nobody thought anything about it until the ninth year. Consequently, they made a rush and the change was made in one year.

This act meets your point, Mr. Chairman, made informally, because it provides that the Government shall educate the people during the 10 years, and that instead of making it a stampede at one time, they will gradually get used to it; the doctors will gradually become accustomed to writing their prescriptions in grams instead of grains, and the pharmacists, instead of having their double sets of weights, will finally be using their metric weights altogether. Practically all of them have them now; some do not.

The CHAIRMAN. That class of people, I appreciate, would readily grasp and assimilate this information. But how about the farmers, the wage earners, and the small storekeepers?

Mr. SCHIEFFELIN. It would have to be a matter of education. Permit me to say that there are over 150 national organizations that have ranged themselves behind this measure and are supporting it, and they are not doing it simply in a perfunctory way. I was at the convention of the National Wholesale Druggists Association two weeks ago at Atlantic City. They have a committee that is called the Committee on the Adoption of the Metric System. That committee reported unanimously in favor of this bill. One man in the back of the convention got up—there were over 150 present from all over the country—and said, "That report ought to be adopted, and, what is more, I want to see that we are behind this. I move that we, all of us, support this measure and that we signify it by rising." The chairman put the motion and all except one stood up. They are very much interested.

I have here a list of organizations and others that are in favor of this bill, together with a copy of a resolution adopted by the Illinois State senate in favor of the adoption by this country of the metric system, and I ask that they be made a part of my statement.

The CHAIRMAN. Without objection, they will be put in the record as a part of your statement.

(The list of organizations, and the resolution referred to, read as follows:)

ONE HUNDRED NATIONAL AMERICAN ORGANIZATIONS AMONG THOSE URGING GRADUAL METRIC STANDARDIZATION OF WEIGHTS AND MEASURES.

American Specialty Manufacturers' Association.
United States Sugar Manufacturers' Association.
National Association of Loose Leaf Manufacturers.
National Paper Box Manufacturers' Association.
National Ornamental Glass Manufacturers' Association.
National Manufacturers of Soda Water Flavors.
National Refrigerator Manufacturers' Association.
National Tent and Awning Manufacturers' Association.
National Sewing Machine Manufacturers' Association.
National Mirror Manufacturers' Association.
Association of Flower and Feather Manufacturers of America.
American Walnut Manufacturers' Association.
National Box Board Manufacturers' Association.
The 4-Ones Box Makers' Association.
National Wholesale Grocers' Association.
Retail Grocers' Association of the United States.
National Canners' Association.
National Preservers and Fruit Products Association.
American Institute of Architects.
National Institute of Inventors.
Periodical Publishers' Association of America.
American Association of Foreign Language Newspapers (Inc.).
National Association of the Motion Picture Industry.
National Association of Music Merchants.

Music Industries Chamber of Commerce of the United States of America.
National Scale Men's Association.
National Consumers Cooperative Association.
Commercial Union of America (Inc.).
Standardization Committee, National Association of Purchasing Agents.
Session on Cooperation, National Foreign Trade Convention, Pittsburgh, 1917.
National Association of Clothiers.
American Wholesale Garment Association.
National Shoe Wholesalers' Association of the United States.
Millinery Chamber of Commerce of the United States.
Millinery Jobbers' Association.
American Woods Export Association.
American Wood Preservers' Association.
National Association of American Wood Pulp Importers.
American Metric Association.
American National Conference on Weights and Measures.
Common Commercial Language Committee.
National Education Association.
United States Section, International High Commission.
International Association for Exports (Inc.).
Franco-American Board of Commerce and Industry.
Alliance Francaise.
National Federation of French Alliances.
Norwegian American Chamber of Commerce.
Holland American Chamber of Commerce.
Swedish Chamber of Commerce of the United States of America.
American Society of Equity.
American Society for Testing Materials.
Railroad Yardmasters of America.
American Warehousemen's Association.
Agassiz Association.
Association of Amateur Scientists.
American Association of Anatomists.
American Entomological Association.
Mathematical Association of America.
American Numismatic Society.
American Genetic Association.
National Congress of Mothers and Parent-Teacher Associations (250,000 members).
American Federation of Human Rights.
American National Food and Dairy Association.
National Conference of Food, Dairy and Drug Officials.
National Wholesale Druggists' Association.
National Association of Retail Druggists.
American Pharmaceutical Association.
National Pharmaceutical Service Association.
National Drug Trade Conference.
American Drug Manufacturers' Association.
National Association of Drug Clerks.
American Nurses' Association.
American Medical Trade Association.
American Surgical Trade Association.
American Academy of Medicine.
American Medical Association.
American Association of Pathologists and Doctoriologists.
Associated General Contractors of America.
National Salt Producers Association.
National Manufacturing Perfumers Association.
National Association of Printing Ink Makers.
Associated Motion Picture Advertisers, Inc.
National Consumers' League.
National Federation of Federal Employees.
International Association of Electrical Workers (180,000 members).
War Mothers of America.
Babson's World Statistical Organization.
American Optometric Association.
Independent Order of Foresters.
Knights of the Golden Eagle.
Rainbow Division Veterans.

Modern Brotherhood of America.
National Child Welfare Association.
United Commercial Travelers of America.
Travelers' Protective Association of America.
National Kindergarten Association.
National Council of Catholic Women.
National Catholic Welfare Council.
National Association of Naval Veterans.
Electrical Manufacturers' Export Association.
American Institute of Electrical Engineers.
National Association of Electrical Contractors and Dealers.
Institute of Radio Engineers.
American Institute of Chemical Engineers.
Institute of Makers of Explosives.
American Association of Pharmaceutical Chemists.
American Electrochemical Society.
Society of Chemical Industry.
American Chemical Society (18,000 members).
American Association for the Advancement of Science.
Pan-American Financial Conferences, 1915, 1920.
Pan-American Commercial Conference.
Pan-American Scientific Congress.
Pan-American Federation of Labor.
First Customs Congress of the American Republics.
International Postal Congress.
International Electrical Congress.
International High Commission.
International Metallurgical and Chemical Society.
International Geneva Association of Hotel and Restaurant Employees.
International Correspondence Schools.
International May Committee.
International Association of Teachers of Printing.
Inter-Allied Scientific Food Commission.
Inter-Racial Council.
World Bureau of Weights and Measures.
World Metric Standardization Conference, 1920.
World's Sunday School Association.
International Sunshine Society.
Northern White Cedar Association (United States and Canada).
American Association of Trade and Commerce, Berlin, Germany.
United States Chamber of Commerce in Argentina.
American Chamber of Commerce in Belgium.
American Chamber of Commerce in Italy.
American Chamber of Commerce in Spain.
International 100% Club (U. S. America and Canada).

[Senate of the State of Illinois. Senate resolution No. 55. Introduced by Mr. Swift, May 3, 1921.]

"Whereas there is in the United States a deplorable lack of uniformity in weights and measures, and the units are unscientific, cumbersome, and unrelated, constituting an actual hindrance to education, industry, world trade, and the activities of daily life; and

"Whereas the metric system of weights and measures is a decimal system, simple, logical, and easy to use, so that its adoption will result in an incalculable saving in time and energy; and

"Whereas the metric system has been adopted by the vast majority of enlightened nations, and its adoption by the United States is calculated to promote friendly relations and commerce with all the world; and

"Whereas the State of Illinois, by reason of its great commercial and industrial activities, is vitally interested, both as a State and in behalf of its citizens, in the speedy adoption of world-wide uniform standards of weights and measures: Now, therefore, be it

"*Resolved*, That the State Senate of the State of Illinois respectfully urges that the units of the metric system be adopted by the Congress of the United States as the legal standard of weights and measures after a transition period of 10 years, as proposed in bills now before Congress; and be it further

"*Resolved*, That copies hereof be forwarded to the President of the United States of America and to the Senators and Representatives of the State of Illinois in the Congress of the United States.

"Adopted by the senate May 12, 1921.

"Presented in the House of Representatives by Congressman Fuller and Congressman Sabath."

Senator JONES. Doctor, have you, or any of those who are interested in this movement, considered any suggestion or compromise as to the time or manner of introducing the system. whether or not it could be taken up in a gradual way?

Mr. SCHIEFFELIN. We thought 10 years was pretty gradual.

Senator JONES. No; 10 years is purely arbitrary.

The CHAIRMAN. Yes.

Senator JONES. To require at the end of 10 years an absolute change would raise the objections to which Senator McNary referred in his informal statement a while ago. I was just wondering if there could be some compromise with the idea of overcoming the objections which have been suggested to a complete change at any definite period of time.

Mr. SCHIEFFELIN. Of course a body that enacts law can postpone it when the time comes if it wants to; it would have that power. This question was brought up at a formal conference and, Senator, it was pointed out that during the war in two months the whole country had learned to go without sugar because there was a propaganda put behind it.

Senator JONES. Let me make one suggestion. Suppose we should fix a definite time when all governmental activities should be carried on under this system?

Mr. SCHIEFFELIN. I thought that was provided in the present bill. Mr. Chairman, I see that this bill carries the provision that the Secretary of Commerce shall take steps, and it will be his job, to educate the people; and if that is feasible it is a good long time when the Government is back of it. I thought it was provided that the Government in a shorter time should be doing its business in the metric system. I believe that was in a former bill.

Senator JONES. Personally I am convinced that it would be better for this country if we had this system, rather than the present. What I would like to know is how we could bring it into existence without an apparent revolution or a complete change.

Mr. SCHEIFFELIN. It seems to me that 10 years is quite a long while, and it might well be provided that the Government in five years should be doing all of its business—and it does more than half of it now—in the metric system. If it was provided that the Government should do it all, then the manufacturers would begin to put out metric goods to a greater extent than they are doing now.

Senator JONES. Don't you think that something of that sort would be better than to just fix this one definite period of time, and what seems to me to be properly termed arbitrary?

Mr. SCHIEFFELIN. I think it would be a valuable amendment to the bill to say that in five years all the dealings of the Government should be in the metric system.

(Whereupon the hearing was adjourned until to-morrow, Wednesday, October 12, 1921, at 11 o'clock a. m.)

71941—21—PT 1——2

THE METRIC SYSTEM.

WEDNESDAY, OCTOBER 12, 1921.

UNITED STATES SENATE,
SUBCOMMITTEE OF THE COMMITTEE ON MANUFACTURES,
Washington, D. C.

The subcommittee met, pursuant to adjournment of yesterday, at 11 o'clock a. m., Senator Charles L. McNary presiding.

Present: Senator McNary (chairman).

Present also: Senator Edwin F. Ladd.

STATEMENT OF MR. ELWOOD HAYNES, PRESIDENT HAYNES AUTOMOBILE CO., KOKOMO, IND.

The CHAIRMAN. Mr. Haynes, the subcommittee is considering S. 2267, a bill to fix the metric system of weights and measures as the single standard of weights and measures for certain uses. Two witnesses were before the subcommittee yesterday.

Mr. HAYNES. My home is in Indiana. I came down here from New York.

The CHAIRMAN. Please give to the stenographer, for the record, your full name, your occupation, how long you nave been in business, and the character of your business.

Mr. HAYNES. My name is Elwood Haynes; I am president of the Haynes Automobile Co., of Kokomo, Ind.

The CHAIRMAN. How long have you been engaged in the automobile business, Mr. Haynes?

Mr. HAYNES. From the time I built the first machine, 27 years ago.

The CHAIRMAN. Are you familiar with the provisions of this bill to which I have just called your attention?

Mr. HAYNES. Yes; I think so.

The CHAIRMAN. In your own way, and according to your own notion, place into the record such material as you desire.

Mr. HAYNES. By way of explanation, gentlemen, I want to say that I am a graduate of a polytechnic school, the Worcester Polytechnic, of Worcester, Mass. I became quite familiar with the metric system during my studies in that institution. In fact, we used it exclusively there in all scientific work. I took as my major course there chemistry.

After graduation, of course, I used the metric system in research work of various kinds almost exclusively, except where I was obliged to use the common or English system because it was in use. For example, in the natural-gas business we always used the cubic foot as the unit of measure for gas because that is the standard in the United States for the measurement of gases in a practical way.

Soon after my graduation from the Worcester Polytechnic I taught two years in high school. I taught the metric system there, more incidentally than otherwise, and I found it very easy to impart a knowledge of that system to the students. I found they took it up very readily and that there was no prejudice in their minds against it, because being a decimal system it appealed to them, and if properly presented it was readily understood.

I want to say, merely to bring out the merit of the metric system, that the meter itself—which as we all know is a little over a yard in length, 39.37 inches, approximately—was derived originally by taking about a one-millionth part of the distance from the equator to the north pole on a meridian passing through Paris, and this was the primary standard for length. That meter was then divided into a hundred parts, termed "centimeters." A centimeter is approximately three-eighths of an inch in

length. A little cubical box, we might say, was made, using this centimeter as the unit, one centimeter high, one centimeter wide, and one centimeter deep. This was filled with water and the weight of that water obtained, and this was termed the "gram." So we sometimes call the metric system the centimeter-gram system.

This linked the unit of length with the unit of weight, and of course when we go into volume by cubing any one of these dimensions we immediately get the weight, without any further calculation, of an equivalent volume of water. For example, if we take a cubic meter, and we find that one side of a liter—one side of a vessel called the liter—is 10 centimeters high, or one-tenth of a meter, if we cube the meter we get 1,000 liters. So that as soon as we cube any dimension, and get its volume in cubic meters, we at once know its capacity in liters, by moving the decimal point over three places, or multiplying by 1,000, which is very readily done.

In order to show the ease of making computations by the metric system as compared with the common system, I just took a problem without any choice as to how the result would come out, or anything of the sort, to determine the number of barrels in a tank which is 20 feet wide and 7 feet high.

The formula for that is $\Pi R^2 h$, in which Π represents the ratio between the diameter and the circumference of the circle, 3.1416——

Mr. DALE. Was it a round tank?

Mr. HAYNES. A round tank, 20 feet in diameter on the inside. Squaring the radius, we have 10 times 10, and multiplying that by $\frac{22}{7}$ and by 7, the result comes of 2,200 cubic feet. It is quite easy to determine the contents in cubic feet, but we do not know the weight of the water, and in order to determine the weight of the water we must multiply the number of cubic feet by 62½, which is approximately the number of pounds in a cubic foot. Multiplying 10 by 10 makes 100, and multiplying 7 by $\frac{22}{7}$ gives 22; 22 times 100 is 2,200. Multiplying that by 62½, the weight of a cubic foot of water, we have 137,500 pounds for the weight of 2,200 cubic feet of water.

In order to determine the number of gallons in that first, so that we may afterwards get the number of barrels, we must reduce to inches, there being 231 cubic inches in a gallon; we multiply the 2,200 cubic feet by 1,728, the number of cubic inches in a cubic foot, and we have 3,801,600 cubic inches. Dividing this by 231, the number of cubic inches in a gallon, we obtain the quotient, 16,457 gallons. Dividing the 16,457 gallons by 31, the number of gallons in an ordinary barrel, we have 530.8 barrels.

That completes the problem and gives us 530.8 barrels. I won't vouch for the correctness of these figures, but I believe the multiplications and divisions are correct.

I think perhaps you can see from where you are sitting the space occupied by this computation just given.

The CHAIRMAN. Which, so that the record may show it, covers about one-third of the letter.

Mr. HAYNES. Yes. On the other side of the paper, to the right, I have made the computation in the metric system, and that [indicating] is all the calculation there is. I took a different sized tank because in calculating in meters a meter, of course, is much longer than a foot. So I took a tank 4 meters wide and squaring that gives us 2, and multiplying by $\frac{22}{7}$ and by 7, gives us 88 cubic meters. It is only necessary to add three ciphers and at once we have it not only in liters, which is the unit of measure for the metric system, 88,000 liters, but also in kilograms. So we have the whole thing there.

Mr. STUTZ. Is that a round tank?

Mr. HAYNES. Yes.

Mr. STUTZ. Four meters in diameter?

Mr. HAYNES. Yes.

Mr. STUTZ. How high?

Mr. HAYNES. I made it 7 meters high. That is pretty high, I know. It is a different shaped tank from the other. But in each case I introduce the unit 7, so as to facilitate the use of Π R, and I gave both systems the benefit of the number 7, so that there was nothing given to the metric system that was not given to the other.

The CHAIRMAN. Do you wish to submit that problem to be inserted in your statement?

Mr. HAYNES. I did not prepare it for publication, but it can go in.

The problem referred to is as follows:)

$$\Pi R^2 h$$

$$7\times10\times10\times\frac{22}{7}=2{,}200 \text{ cubic feet.}$$

```
  62.5
   2,200
  ------
 125,000
125
 ------
137,500.0=137,500 pounds.

   1728
    2200
   ------
   345600
  345600
  ---------
231)3801600(1645 gallons.
    231
    ---
    1491
    1386
    ----
     1056
      924
     ----
     1320
     1155
     ----
      1650
      1617
      ----
        33

   31)16457(530.8 barrels.
       155
       ---
        95
        93
        ---
        27
```

$$\frac{22}{7}\times7\times2\times2=88 \text{ cubic meters}=88000\begin{cases}\text{Liters.}\\ \text{Kilograms.}\end{cases}$$

he CHAIRMAN. Of course such a formula as that relates to the mathematics of question. We are particularly interested in the legislative and practical side . Can you discuss the question from that standpoint?

r. HAYNES. That is what the farmer would have to do if he wanted to know how h a tank would weigh, how big a foundation he would have to have, or what he ld have to do if he wanted to know how many barrels of water there would be cistern he was going to dig. I would like to know how many of you men have a rn in your home and how many barrels it holds, and whether you know how many ons to the barrel were estimated in that—whether it is a little barrel about as high hat [indicating], or whether it is a kerosene barrel, which has 50 gallons. Some els hold 31. There are many kinds of barrels. There is one with a capacity gallons, there is the 31-gallon barrel, the 36-gallon barrel, the 48-gallon barrel, the 50-gallon barrel. We have so many units in our common system that it is essary to specify what you mean by a barrel.

n the metric system we always know what is meant by a liter, because it is always same; we always know what is meant by a cubicmeter, because that is always

the same. If we want to know the number of liters in a cubic meter it is only necessary to move the decimal point to the right three places, and at once we have it.

The CHAIRMAN. You favor the adoption of this system, I presume?

Mr. HAYNES. Very decidedly.

The CHAIRMAN. Have you read the bill we are now considering at this hearing?

Mr. HAYNES. Yes, I have read it over.

The CHAIRMAN. Is there anything in the bill you would specially commend or alter or omit?

Mr. HAYNES. I think the bill is quite practical. Of course I should want to give the matter some study before I gave an opinion of it.

The CHAIRMAN. It is effective 10 years after its passage, that being the arbitrary date fixed. Do you believe that to be practical also?

Mr. HAYNES. I think that is plenty of time.

The CHAIRMAN. What effect would the adoption of this system have on our commerce with foreign nations, if any?

Mr. HAYNES. I believe, if I am correctly informed, that all of the civilized foreign nations use the metric system with the exception of Great Britain.

The CHAIRMAN. And this country, of course.

Mr. HAYNES. Yes. I was speaking of foreign nations.

The CHAIRMAN. That does not hardly answer the question. In the automobile business you sell abroad, do you?

Mr. HAYNES. Yes.

The CHAIRMAN. Have you found any difficulties in the use of the two systems, here and abroad?

Mr. HAYNES. In the automobile business we make an assembled unit, and of course we are not called upon for metric measurements. It would only be in repairs that this would be used. We generally make them of course in the English system, because we are prepared to do it.

There is one other thing that I would like to mention in connection with this matter, and that is that under the present system we have not only the metric system but we have the common system, and transforming from one set of values into another is always a very troublesome process. I always dislike very much to be called on to transform, for example, grams into pounds—that is comparatively easy, for I happen to know that there are 453 grams to the pound. But to be called upon to transform cubic feet into meters, and things of that sort, is a very unwelcome request.

I think, furthermore, that the time saved in the schools in teaching is a very important item. If the Government takes hold of this—I am a member of the school board for Indiana, and I shall certainly very strongly advocate the teaching of the metric system and help in getting the young students ready for it, so that when they come into practical contact with it they will be prepared for it, and it is very much easier.

I might give as an illustration the tables of weights that we have. We now have three tables of weights in our common system. We have 20 grains equal 1 scruple; 3 scruples, 1 dram; 8 drams, 1 ounce; 12 ounces, 1 pound. That is what they use in drug stores mostly. Then we have the Troy or mint weight, as it used to be called, 24 grains make 1 pennyweight; 20 pennyweights, 1 ounce; 12 ounces, 1 pound. Then we have the avoirdupois weight, 16 ounces make 1 pound; 25 pounds, 1 quarter; 4 quarters, 1 hundredweight; and 20 hundredweight, 1 ton. This, together with all the different-sized barrels.

Then we have different gallons. We have the imperial gallon. We do not use it in this country, but it is almost universally used in Canada. It takes about 10 pints or 10 pounds of water approximately to make an imperial gallon, while it takes about 8 to make the gallon we use.

The CHAIRMAN. What time do you think would be saved in the schools to the students?

Mr. HAYNES. I should say roughly a year to a year and a half. I believe I could teach the metric system in 10 days so that the students would take it up and be able to work it. It would take a year or two to get the other. If we were to take up all the tables, have them commit them all and then become familiar with their operation, it would take a year to 18 months; possibly with some students longer than that. It is hard to retain those things in the mind.

Mr. DALE. Do you say a year and a half?

Mr. HAYNES. Yes; I should say a year and a half.

Mr. DALE. Is that with the high school included?

Mr. HAYNES. I think they commence before the high school.

The CHAIRMAN. What is your name, so that we may know for the record?

Mr. DALE. Mr. Dale, of Boston.

The CHAIRMAN. What is your business, Mr. Dale?

Mr. DALE. I am editor of Textiles.

The CHAIRMAN. Is there anything further, Mr. Haynes, you would like to mention in connection with this proposed legislation?

Mr. HAYNES. There is one phase that I have not mentioned, and that is that nearly all research work is done in the metric system. We are dependent upon the research work of the scientists for a large part of our industries. They work this out in the metric system because it is simpler, more logical, and can be handled with much greater facility. Then it all has to be transformed into the common system, which is a laborious process, a cumbersome process. When the scientist is called on to make any investigations, he makes them in the metric system and then he is obliged to transform them into the common system, which makes it rather difficult sometimes.

I remember some years ago we were determining the quantity of moisture in natural gas. The president of the company, a rule-of-thumb man largely, went by a little book he carried in his pocket. When we got the moisture in a certain number of cubic feet of gas as so many milligrams, he brushed it all aside and said he did not know anything about milligrams; he wanted it in pounds and ounces. That is an example of what takes place. We had to get it in milligrams because our balances and our weights were graduated in milligrams.

Mr. CROCKER. Senator McNary, could I suggest a question to be asked Mr. Haynes?

The CHAIRMAN. Certainly. Does the record show your name?

Mr. CROCKER. No—W. M. Crocker. May I suggest you ask Mr. Haynes whether or not he believes the metric system could be brought into the manufacturing industry eventually at a minimum cost?

The CHAIRMAN. That is a very proper question.

Mr. CROCKER. What he believes along those lines in regard to the introduction of the metric system. The provisions of this bill do not apply to the production end, but at the same time if the metric system were to be brought in later on, how would it affect industry?

Mr. HAYNES. I think it would have very little effect. There is no reason why we can not take a lathe, for example, and turn to the metric system sizes whenever we are disposed to do it. We do not have to throw away all pieces of machinery. That is true of a large number of machines. But the jigs and taps that are fixed in their dimensions, they wear out anyhow once in a while and have to be bushed or something done to them to keep them standardized.

The CHAIRMAN. Does anyone desire to ask Mr. Haynes a question? If not, that will be all, Mr. Haynes, and we thank you very much for your presence and helpfulness to the committee.

STATEMENT OF MR. ARTHUR BESSEY SMITH, CHIEF RESEARCH ENGINEER, AUTOMATIC ELECTRIC CO., CHICAGO, ILL.

The CHAIRMAN. Mr. Smith, give the reporter your name, address, and occupation.

Mr. SMITH. My name is Arthur Bessey Smith; my title is Chief Research Engineer, Automatic Electric Co., Chicago, Ill.

The CHAIRMAN. How long have you been engaged in this work, Mr. Smith?

Mr. SMITH. About 12 years.

The CHAIRMAN. Have you read the bill offered by Senator Ladd to fix the metric system as the single standard of weights and measures in this country?

Mr. SMITH. I have read it rather superficially.

The CHAIRMAN. You have some familiarity with the subject of this proposed legislation?

Mr. SMITH. Yes. I have used the metric system in my laboratory for at least six or seven years, and our company is preparing to operate upon the metric system exclusively.

The CHAIRMAN. Proceed, Mr. Smith, in the way you prefer, and place in the record such material as you think will be of advantage to the committee.

Mr. SMITH. The Automatic Electric Co., with its predecessor, has been in the business of manufacturing the automatic telephone for more than 30 years. It is this system which displaces the operator and permits the subscriber to obtain the number directly by spelling out the number on a small dial.

My own personal experience with the metric system dates back into the public schools where the metric system was taught. I am a graduate of the University of Nebraska, in electrical engineering. In the laboratories, physical and chemical, the metric system was used exclusively. At that time I found the greatest ease in working in the system.

After I took charge of the research work for the Automatic Electric Co. I began to use the metric system exclusively in our research work, converting from English or to

English only as we came in contact with the factory or the outside world. The advantages which we have found from the use of the metric system for our measurements and calculations are so great that we can afford to make that transformation whenever the outside departments are involved.

Mr. A. E. Keith was our chief engineer until this spring. While he was still our chief engineer—it was, I think, late in 1920—he told me that it was his desire to place the factory upon the metric basis, and outlined briefly his proposal of how it was to be done, giving me instructions as to what I should do. I wrote letters to a number of people who were using the metric system, because we felt that the evidence given by people who are successfully using a thing is better than those who are merely thinking about it.

Among those from whom we had letters were Mr. Miller of the DeLaval Separator Co., and from the Goodyear Tire & Rubber Co. Later on I met personally Mr. Andrews of the Eisemann Magneto Co., and a gentleman by the name of Wells, connected with the Greenfield Tap & Die Corporation.

The plans to convert to the metric system are based along the following lines. The factory would within itself work entirely upon the metric basis. There would be made no change whatever in the dimension of any parts of our apparatus, either of the machines which we use or of the finished product. We will continue to use the same system of wire—I should say many systems, because they are drawn to many gauges, the Brown-Sharpe gauge, the Birmingham wire gauge, etc., and the usual standard machine screws. But whenever the stock of any part ran low the stock clerk would requisition the purchasing department to buy whatever was necessary. The purchasing department will be the point of contact with the outside world, and if the rest of the United States is still upon an English basis they will fill the order with different English measures which will give the desired stock.

We have already been using a similar system with regard to materials, carrying certain materials in our stock by one name and permitting the purchasing department to buy under a different name. Thus they can secure goods which will give us the desired specifications. We use phenol fiber in our manufacture, but it can be bought under the name of micarta plate, formico, etc. We also use resistance wire, which we call No. 1, which must have a negligible temperature coefficient, which may be filled with manganin wire.

The first step in the change will be to add the metric dimensions to our drawings. These will be added only as drawings come up for correction in other details. There is always a constant stream of drawings passing through our change order department for changes of one kind or another. Very suitably prepared tables of metric dimensions will be added. At the same time all new drawings will be dimensioned in metric, with the English measure added so that it can be easily erased.

At the proper time those machines in the factory which require any physical change will be changed. I have made a survey of the factory, employing on the work my own assistant, Prof. P. G. Andres and Mr. T. C. Whiting, assistant to the master mechanic. The latter gentleman was not disposed to favor the metric system very much, largely on account of the cost which he feared would be involved in making the change. He had been frightened by reports of fabulous sums that would have to be spent to change over to the metric system. After this report was nearly completed he revised his opinion and said that the cost was practically negligible.

It was my desire to have placed upon this summary all measuring tools used in the factory and all the changes in the parts of machines in our model shop and the tool machine shop, so that the sum total of cost could be put in the record at once; but this hearing came off sooner than I expected, and I had to cut this part short. I ask, if you desire it, to place that in the record, and to permit the sum total cost to be added as soon as I can get the accurate figures.

The CHAIRMAN. How long will that be, Mr. Smith?

Mr. SMITH. I could do that within two or three days.

The CHAIRMAN. We would not want to hold up the printing of the record very long for a lot of figures.

Mr. SMITH. Oh, there would not be many; perhaps not over two.

The CHAIRMAN. Very well.

Mr. SMITH. I expect to return to New York to-night.

The CHAIRMAN. Very well; this may go in the record.

(The paper referred to is as follows:)

Measuring tools used in factory of Automatic Electric Co.

	Ownership.		Total.
	Personal.	Company.	
Micrometer caliper, ½-inch		1	1
Micrometer caliper, 1-inch	157	6	163
Micrometer caliper, 2-inch	72	3	75
Micrometer caliper, 3-inch		5	5
Micrometer caliper, 6-inch		1	1
Inside micrometer caliper, 1-inch	6		6
Inside micrometer caliper, 2-inch		1	1
Micrometer depth gauge, 1-inch	1		1
Special micrometer head		4	4
Depth gauge, 6-inch	4	1	5
Depth gauge, 18-inch		1	1
Vernier height gauge, 6-inch		3	3
Vernier height gauge, 12-inch		3	3
Fillet gauge	1	5	6
Starret dial indicator	1		1
Mica dial gauge		1	1
Double protractor and scale		1	1
Scale, 6-foot	237	56	293
Scale, 12-foot	92	2	94
Scale, 2-foot		1	1
Scale, 3-foot		2	2
Thickness gauge	1	456	457
Machine square, 4-inch	1		1
Machine square, 12-inch	4		4
Machine square (not specified)	42	14	56
Carpenter's square, 2-foot	6	22	28
Square, 12-inch		10	10
Rule, 2-foot	14		14
Rule, 3-foot		10	10
Rule, 6-foot	38	1	39
Boxwood rule, 12-inch	5		5
Cloth tape, 50-foot	2		2
Cloth tape, 100-foot		1	1
	684	611	1,295

Change of Parts on Machines in Model Shop and Tool Machine Shop of Automatic Electric Co.

DEPARTMENT 25 (MACHINE SHOP).

Drill presses: No changes required.

Lathes: No change required.

Punch presses: No change.

Filing machines: No change.

Shapers: Three shapers will need new head adjusting screws and dials, new traverse screws and dials, a new ram travel scale, and a new feed change plate.

Grinders: (*a*) The surface grinders will require no change. (*b*) The cylindrical grinder will need to have its scale recalibrated.

Milling machines: (*a*) Three bench milling machines will require two new screws. Cost, $30; labor, 4 hours; total cost, $111.60. (*b*) Twelve milling machines will require two new screws each. Cost per pair, $60; labor, 16 hours; total cost, $965.60. (*c*) Vernier milling machine. Change scales on cross and traverse feeds. Change micrometer stop calibration.

Planer: Change vertical feed screw and dial.

According to the foreman of the department, Mr. Wolney, only the milling machines need to be changed. This was also the opinion of Mr. R. D. Campbell, of the tool-designing department.

DEPARTMENT 15 (MODEL SHOP).

The changes in department 15 are exactly like those of department 25. Two horizontal milling machines and one shaper need to be changed.

COST OF CHANGING TOOLS AND MACHINES TO METRIC SYSTEM, AUTOMATIC ELECTRIC CO.

Replacement of all measuring tools, both owned by the company and by the men		$3,905.26
Changing machines in the tool machine shop:		
3 shapers, at $55	$165.00	
4 grinders, at $5	20.00	
3 bench milling machines, total	111.60	
12 milling machines, total	965.60	
1 vernier milling machine	50.00	
1 planer	40.00	
		1,352.20
Changing machines in model shop:		
2 milling machines, at $80	160.00	
1 shaper	55.00	
		225.00
		5,482.46

It is safe to take $6,000 as a fair value of the tools to be replaced and the changes in machines which will need to be made.

Mr. SMITH. The people who need to use the metric system will be instructed briefly in its use. Our method of teaching the metric system is to teach people to use it the same way that a child approaches any measuring system which he finds in use in the country in which he happens to be born.

I have made the following experiments with young people and adults. I have shown a metric scale; briefly explained the distance between each mark as one millimeter, and the decimal numbering; have asked the person to measure a number of familiar objects in the room or on the table; then have asked that person to lay aside the rule and estimate the length of some object which had not been measured previously; then to check up that object by measuring it with the scale, and have been surprised to notice that within a few minutes the person is estimating distances within perhaps 5 or 10 per cent accuracy.

A mechanic's best resource is his sense of proportion, not in fancied possession of absolute distance. The sense of proportion is the great thing which every good mechanic possesses.

We found also that there are very, very many of the tools in our factory which require only restamping, and our limits gauges are all of this character.

So that the expense involved is very, very little and the change in the use of the apparatus is nothing at all, because the finished part must pass through a certain opening and not pass through another one, or else it is rejected.

Then finally when enough of the drawings have been changed we will change the factory to the metric basis, over all at once, the people having been suitably instructed before. From that date all of the new drawings will be made with metric dimensions only, and the drawings which come up for changes will have the English erased.

Our chemical department has, of course, always been running on a straight metric basis. I think it would be impossible to get a chemist to consent to hamper himself by using any other system.

The research laboratory, of which I have charge, now uses the metric system and has for a number of years, as stated before. We do it because of the ease of measurement, everything being strictly decimal, and the great ease of computation; also the great ease of transforming from one kind of unit to another: as, for instance, compound units, volumes, and so forth.

Just for example, we need to put into our transmitter a certain volume of granular carbon in order to fill the mircophone cell with the proper amount. We fix this as a certain fraction of a cubic centimeter, and in making up a measuring cup for use in the factory we simply drill the cup to such a depth that the weight of water in the cup in grams is what we desire in the cubic centimeter.

Some time during the last year I stopped into our druggist's and asked the pharmacist, if the doctors should begin to write their prescriptions in metric, how long would it be before the druggists of the country could begin filling in metric. He laughed and said, "Why, half of the doctors in our vicinity are writing their prescriptions already in metric, and we are filling them directly in metric."

Mr. CROCKER. May I ask Mr. Smith a couple of questions?

The CHAIRMAN. Yes.

Mr. CROCKER. Mr. Smith, do you believe that if the metric system is adopted in your plant that the ultimate gain out of the small loss that might accrue would far

offset it? That is, how long after you have changed over will you make up for the cost of your change? Could you make an estimate upon that?

Mr. SMITH. We propose to charge off the cost of changing over a period of 5 or 10 years. The actual money outlay will be practically insignificant compared with the total volume of business which we do, which will run between four and five million dollars a year.

Mr. CROCKER. Are you willing to go even further than the provisions of this bill? As you know, the bill only requires the use of the metric system for commercial practice; it does not go into the methods of production. Are you willing to go a step further than the bill provides and use it in production? That is, if the bill becomes effective after a period of 10 years, according to its proposed provisions, would you be willing to go further and use it in your methods of production?

Mr. SMITH. Yes; the plan I have just outlined proposes to go ahead whether this bill goes through or not. We feel that we can not longer deprive ourselves of the advantages of the simplicity and economy of using this system. That is a settled point with us.

Mr. CROCKER. How about the engineers in general that you have talked to on this particular question? Is it your general impression that a majority favor the gradual adoption of the metric system?

Mr. SMITH. The engineers to whom I have talked in our own organization, and to which I would like to confine myself, almost all of them are in favor of it. They say, "If the company goes metric, we go metric with it and will be glad to use it." We have a few who oppose, but they are decidedly in the minority and will not influence the matter, will not interfere with it in the slightest.

The fear of most of them is based upon the still mistaken notion that we are going to throw out all the screws and dimensions and change everything to integral millimeter dimensions, which is not true; we will not change one thing. We will leave our apparatus exactly unchanged.

Mr. CROCKER. How would you say they got an impression like that? Would you say just by reading some propaganda, or something, and not looking into the question themselves? How would you say they had arrived at a conclusion like that?

Mr. SMITH. Literature has been sent into our factory and it has come to me, stating that it would require a change of tools and dimensions. I think that is the source of their fears.

The CHAIRMAN. As a practical question, Mr. Smith, I ask this to get your judgment. Do you think the Government should impose this system upon the people by statutory enactment, setting an arbitrary date, or should it be brought about through a gradual approach, being taught in the schools to the young, and adopted by those who believe in the system that you just outlined a minute ago?

Mr. SMITH. I do not know that I am in position to express myself on that. Our plan is that we are going to go ahead ourselves. It will make it easier for us. It will be of assistance to us and to every other manufacturer that wants to progress, if the rest of the country comes with us.

The CHAIRMAN. Do you think legislation of this kind is important or would be valuable and popular, or is needed?

Mr. SMITH. I think the change to the metric is very greatly needed.

The CHAIRMAN. Can that be brought about in the way you have indicated you are going to do, through the teaching of it in the schools of the States, or should it be forced upon the public?

Mr. SMITH. We have had a lot of other things forced on us, and I am inclined to think that, inasmuch as we are law-abiding citizens, if a law like this is passed we will all fall in line and obey it.

The CHAIRMAN. I appreciate that, of course; but that is not at all an answer to my question. You say you are going to adopt the system, whether others do or not. Others have the same privilege. You have given this matter thought, and I want a frank expression of opinion, if you have it—if you have not, all right—whether you think it is necessary to invoke legislation of this character which would make the change obligatory, or whether it should be left as it is to each institution or organization to adopt the plan if they so desire?

Mr. SMITH. I believe if we leave it to individual initiative the thing will drag out unduly. I believe we will have to have legislation to help us through. So I answer yes to your question.

The CHAIRMAN. Do you think that people who are not engaged in the line of work you are—such as the wage earner, the salaried employee, the farmer, and people of that class—would gain anything by the adoption of this method, and would yield to it readily and willingly?

Mr. SMITH. They will gain by it and will yield to it readily. The contact that I have had with engineers and with laborers——

The CHAIRMAN. Engineers and that class of people are a different proposition. Of what advantage is it to the farmer out in North Dakota or to a fruit-grower in Oregon? That is what I want to get at. Of what advantage is it to the storekeeper in a small town, or to a man working, in or out of the union, in the mines, in the factory, and fields? I am not talking about the particular class of people to whom you have referred.

Mr. SMITH. If we erase the farmer, because I am not a farmer, and am not sufficiently in touch with him to be informed, I would say as to the storekeeper and the other trades people, as to the salaried folks and the ordinary home-keeper, yes, they will benefit greatly by it.

The CHAIRMAN. How?

Mr. SMITH. Because of the great simplicity of the system. And every school child is going to be greatly benefited by it, by the shortening of the time required for learning the measurements.

The CHAIRMAN. My mind is entirely open on this subject, and these questions are to try and develop both sides. I entertain at this time some doubt as to whether the average women who makes bread would desire to adopt this formula which I see in this pamphlet. She knows what a pinch of butter is or a cup of flour or a cup of water I read from "Metric Weights and Measures," published by the American Metric Association:

"Flour, 3,000 grams; water, 1 liter or 1,000 grams; butter or lard, 28 grams; sugar, 15 grams; salt, 15 grams; yeast cake, 12 grams."

Now, would mother desire to adopt this new method, in the making of a loaf of bread? I am wanting to know as a practical proposition. Take the farmer, who knows what a bushel of apples means or what a sack of grain holds, whether sewed or tied. Would he enjoy being compelled to lay aside all those old weights and measures and adopt a new system?

Mr. SMITH. Mother will use the teaspoon, which will be 5 cubic centimeters. Mother will use the tablespoon, which will be about 15 cubic centimeters. When she picks up a formula, or, we will say, a recipe, and it says use so many cubic centimeters, she will count out 5 or 15 every time, and there she has got it.

The CHAIRMAN. I am glad to have you so optomistic.

Mr. SMITH. I have been living with my wife for some 20 years. Also when she goes to the store to buy cloth she will get a little bit more for what she thought was a yard before; she will get a meter of cloth. She just simply revises her ideas a little bit. When she goes to buy a couple of pounds she will simply call for a kilogram instead. The easy transformation from the yard to the meter and from the pound to the half kilogram is so slight; also I might say from the quart to the liter—it is so easy that you can make the change over night.

Mr. HAYNES. Would it be in order for me to make an observation at this point?

The CHAIRMAN. Certainly; we will be glad to hear anything you have to say which you think will enlighten the committee.

Mr. HAYNES. I have one thought which I think is pertinent to the question. When I entered the Polytechnic, 42 or 43 years ago, they had up the question of the metric system. Its merits were recognized at that time and it was used in that polytechnic institution, as I have already stated, exclusively. They did not have any pounds or ounces or quarts in the whole thing. It was said then that the difficulty of introducing it was that it would cost a considerable amount, and there was a public prejudice against it. That was 42 years ago. It was taught more in the public schools at that time, and immediately after it, than it is to-day. We never have got anywhere with it, and I do not think we ever will until it is made compulsory. Then we would get there pretty fast.

You were speaking of mother. I think Mr. Smith is right in regard to the mother. The mother will still use the teaspoon, or some of them will; but the daughter will say, "Mother, you just weigh it out on the scales," and scales are becoming common now in the kitchen—"Just weigh it out on the scales." This is so many grams. It is just as easy as anything. This is just so many decimals or such a fraction of a kilogram. It is just so easy to run this weight along here and it registers itself. Sometimes the mother won't learn it, any more than the man who won't learn to run an automobile, but the daughter will learn it, because it is simpler. That is my actual opinion.

Furthermore, I think the farmer's boy will welcome it. The older man is conservative, as a rule, and he does not like any new thing. He does not even like to change the cut of his clothes, or things of that sort. He wants the same old styles—sometimes, not always—that they had when he was a young man. That is due largely to prejudice. But as to the class of people that is coming along, I think this bill will be intensely popular with them within a very few years. And if the prop-

aganda is started now in the schools, long before this bill comes into effect it will be very popular.

The CHAIRMAN. That raises the point that I had in mind yesterday, and I might mention it briefly at this time. I am wondering, as a practical proposition, if the next generation, after going through the schooling which is supplied to them so generously in this country, would not accept it better than by having it forced upon those people who are out of school at this time by arbitrary legislation.

Mr. HAYNES. They have 10 years.

The CHAIRMAN. Suppose, Mr. Haynes, that the States would pass a law adopting the system and require it to be taught in the public schools, the generation which was familiar with this system would take it up, of course, and use it. That is one way of approaching it. It would take a generation to do that. I am wondering if that is not a better method than saying to the people, regardless of the advantages of education, "You must accept this system; it is unlawful to use the system you did in the early days, in the school or in your home."

Is that the way to bring about the change in our system of weights and measures?

Mr. HAYNES. If it took a whole lot of study now to do it, if things were exceedingly complicated, if mother had to go back to school to learn it, I would say no, but on account of the simplicity of the system and the ease with which it may be learned, I think the 10-year plan is the better.

The CHAIRMAN. Let me ask you this. Take a man—using the rural figure again—a farmer out here in Maryland, 55 years of age, who has had a common-school education, in the school house at the fork of the roads, perhaps to the seventh or eighth grade, who has read just about what the average farmer has. How long would it take him to become familiar with the system in connection with the things with which he dealt or had to do with?

Mr. HAYNES. That depends somewhat on the caliber of the farmer.

The CHAIRMAN. I am talking of the average farmer. You know what his opportunity for education and study has been.

Mr. HAYNES. I could not give an off-hand answer to that.

The CHAIRMAN. Of course you could not in time. Would it not require a good deal of patience and study, and would he not be disturbed by the necessity of changing from bushels and inches and feet?

Mr. HAYNES. He would be 65 years old before he had to make the change, if he is 55 years now.

The CHAIRMAN. But you know how it would be. Some one testified here if it was 10 years off they would wait nine years and six months before they thought about it.

Mr. HAYNES. I think that would be his own fault, would it not?

The CHAIRMAN. Under that proposition he must study measurements of this kind. The farmer would not start to study this system until a month or two before.

Mr. HAYNES. I would sum up my opinion in this way. If they do not have something staring them in the face they are indifferent about it. It makes little difference what the period of time is. They do not make any more preparation than they have already. Thirty or thirty-five years ago more attention was given in the schools to the metric system than there is given to-day. If we pass this legislation immediately they will get busy and commence to learn it, and by the time it goes into effect you will find a very large number of progressive young men, and young women, too, for that matter, strongly in favor of it, and they will fall right into line.

The CHAIRMAN. I have no doubt that after people are forced to learn it in the schools they will carry it on, every one of them. But they are small in comparison to those to-day who are adding to the wealth of the country and have passed beyond the days of schooling. Those are the ones about whom I am thinking at this time.

Mr. HAYNES. I do not think there ever will be a time that you can introduce it when everybody will fall for it, to use a slang expression. Some people were opposed to the locomotive, some were opposed to the steamboat, some were opposed to the automobile. As to everything there will be a certain number of people who will always be a drag to progress. And simply because that is true, I do not know why the legislation should be deferred another decade.

The CHAIRMAN. Suppose we were to go at it more gradually than is proposed by this bill, not proposing any form of legislation, and the Government in all of its dealings would make its system the metric system. Would that be such an example as that the individual would follow?

Mr. HAYNES. I think that would help. I think the factories and the industries of the country would be influenced a good deal by the Government taking it up and adopting it, especially if they had any work to be done for the Government.

The CHAIRMAN. Mr. Smith, was there anything more you wanted to say?

Mr. SMITH. Only I might simply add that children who are taught the metric system in school will get out of the habit of using it, unless it is in use in the place where they work after they get through school. In other words, we would probably lose a great deal of the effect of the school unless they are permitted to use it at once upon getting out into the world.

I think that is all.

The CHAIRMAN. Is there any other witness?

Mr. CROCKER. That is all to-day. I would like to say something on that question, if you would like to hear me.

The CHAIRMAN. Don't you want to appear as a witness later on in the hearings?

Mr. CROCKER. Yes.

The CHAIRMAN. Of course, if there is anything you want to add now, you may do it.

Mr. CROCKER. Referring to the illustration of the farmer which you took, in that particular case I would answer that along the lines of Mr. Haynes's reply, by saying that you can not please everybody. There is opposition from somebody to everything put through Congress.

The CHAIRMAN. That is true.

Mr. CROCKER. The farmer does not have to use weights and measures to any great extent to sell his products. If he takes his wheat to the mill they weigh it at the mill. When he takes his corn they weigh it for him. When he takes his milk to the creamery they do not take his word for it; they measure it. So he has comparatively little use for weights and measures, and it would not affect him a great deal.

On the other hand, in the matter of getting a standard of weights and measures, the Constitution says that Congress shall fix the standard of weights and measures. That has never been done. Different weights and measures are in use, and we really have not a standard system of weights and measures in the United States—what you would call a legal single system, a legal standard. As I say, there are different weights and measures in use all over the United States. For instance, there are 56 different kinds of bushels, which affects the farmer right straight through. He is confused now. When he sells a bushel of wheat or corn, if he does not have the exact weight clearly in his mind he has to look it up. A man dealing in wheat and corn would appreciate the point I am making; he has to know the different kinds of bushels all over the country.

It seems to me that the farmer would welcome a uniform, single system of weights and measures, so that when he was buying or selling a ton of wheat he would know exactly what he was doing. He would not have to think whether it was a long ton or a short ton. And when he was buying coal from the coal dealers he would know that he was getting a metric ton. He would not be buying a long ton and have the man ship him a short ton and make some extra money in the difference in the weight of the two tons.

It seems to me that if the metric system was explained to the farmer, as to its advantages, he would fall right in line.

The CHAIRMAN. He would have to know the tables of length, would he not, the tables of area, the tables of volume, the tables of capacity—if he is selling his land or planting it, and with respect to trees, shrubbery, bushes of any kind, where he has a plan to follow; also in the sale of his produce and the buying of material. I think he would have to have a general knowledge of the whole subject, just as any other individual.

Mr. CROCKER. For his own personal use, and on his own farm, the legislation would not affect him at all. According to the legislation as proposed he could use what he wanted to on his own farm. It would only be with his dealing with the outside world where he would have to use it.

The CHAIRMAN. I think it must be conceded that if the Government imposes this system we will all have to conform to it, whether we are on the farm, in the laboratory, the keeper of a store, or a manufacturer.

Mr. CROCKER. The bill provides for the commercial use of the metric system only. It does not affect individual use of weights and measures. You would only have to use the metric system when dealing with others where weights and measures are involved. The farmer whom you have pictured, I believe, would not object to the metric system if he could see how it would benefit posterity. He would be very glad to help his country by submitting to a temporary slight inconvenience in weighing and measuring.

The CHAIRMAN. Mr. Haynes and Mr. Smith, we thank you cordially for coming down here. You have been of great help to the committee. We will adjourn until 11 o'clock to-morrow morning.

(Whereupon, at 12.15 o'clock p. m., the hearing was adjourned until 11 o'clock a. m., to-morrow, Thursday, October 13, 1921.)

THE METRIC SYSTEM.

THURSDAY, OCTOBER 13, 1921.

UNITED STATES SENATE,
SUBCOMMITTEE OF THE COMMITTEE ON MANUFACTURES,
Washington, D. C.

The subcommittee met pursuant to adjournment of yesterday, at 11 o'clock a. m., Senator Charles L. McNary presiding.

Present, Senator McNary (chairman).

Present also, Senator Edwin F. Ladd.

STATEMENT OF MR. HOWARD RICHARDS, JR., SECRETARY AMERICAN METRIC ASSOCIATION, NEW YORK, N. Y.

The CHAIRMAN. Mr. Richards, for the benefit of the record, kindly give to the reporter your full name, address, the position you occupy, and the experience you have had.

Mr. RICHARDS. Howard Richards, jr.; Yale, 1900, electrical engineer; Columbia University, electrical engineer, 1903; Metropolitan Street Railway Co.; New York-Edison Company; Science Department, Boone College, Boone University, China, teacher of physics; secretary American Metric Association since 1916. I think that will be sufficient, Senator.

The CHAIRMAN. Yes. Mr. Richards, the committee is considering S. bill 2267, for the purpose of fixing the metric system as the single standard of weights and measures in the United States. I assume you have read the provisions of the bill and know its general purposes.

Mr. RICHARDS. Yes, sir.

The CHAIRMAN. The committee of course wants to go into this subject as thoroughly as possible, in order to have light shed upon it from all sides. In view of your well-known experience as secretary of this association, in educational work, we would like to have you discuss the subject in your own way. I do not know how you want to proceed.

Mr. RICHARDS. That is good of you, sir. I will start with the request that you and Senator Ladd, and any others, will not hesitate to interrupt at any time and ask questions.

First I would like to take up the matter of the practical use of the metric system and its advantages.

The measures of length lend themselves with special readiness to practical everyday transactions. This is shown first by the elimination of fractions. Instead, for instance, of speaking of five-sixteenths of an inch we speak, in dealing with machinery, of 8 millimeters. The method of measuring is illustrated on the first sheet of the third edition of "Metric Weights and Measures." If, for instance, as shown on page 2, a man's stride is 80 centimeters, in 10 steps he covers 8 meters; in 100 steps he covers 80 meters. This calculation, and similar ones, are only possible by the use of a simple decimal system.

The method of measuring areas is also so convenient that it appeals to the farmers, people who have the task of planting. For instance if 50 grains of wheat are needed for one square meter, for one square kilometer 50,000 grains are needed. In no other system is this convenience possible.

The method of measuring volumes is even more convenient. As one cubic centimeter of water weighs 1 gram, 1 cubic meter of water weighs one metric term; and similar calculations are also facilitated.

The same thing applies to the matter of weights and measures. On page 3 of this booklet is noted, for instance, a recipe for making bread, where you have the ingredients all noted in one and the same unit. It facilitates the making of any commodity according to a simple rule. It is strikingly practical.

If we will consider that we understand the working out of the system, Senator, I would like to pass on to my experience in seeing it used in different parts of the world.

The CHAIRMAN. I think that would be interesting. The mathematical part of the plan has been worked out pretty well. This little pamphlet to which you have referred has already been placed in the record.

Mr. RICHARDS. In 1905 I first went to work in China. Wu Chang is situated directly across the river from the Hang Yang Iron & Steel Works. This works is connected with the Ta Yeh iron mines and the Ping Shang coal mines. Altogether they employ approximately 5,000 hands.

One of my tasks was to train young men for work in these plants. I had access to the factories and made frequent trips over them. I found that not alone the chemical and industrial parts of the business were carried on entirely in the metric system, but that, other things being equal, they strongly preferred to deal with those nations which used the metric system.

Incidentally, please, if anyone here thinks I am mistaken in any of this evidence, I wish they would come right out——

The CHAIRMAN. Go ahead with your testimony without anything of that kind.

Mr. RICHARDS. The matter of using this system was so practical and so convenient that I never heard the advisability of China adopting the metric system questioned.

I have here an abacus. The abacus is used throughout China for calculations of all kinds. It will be noted that it counts by units—tens, hundreds, and thousands. This coincides to American currency, Chinese and Japanese currency, and metric weights and measures.

I need not emphasize the fact that the Chinese in their transition to the metric system have established a foot of 32 centimeters in length, divided into 10 divisions of 32 millimeters each. China, as does the United States and England, deals direct with the International Bureau of Weights and Measures, and depends solely on the international metric standards for its measures. Not only is this metric standardization true in China but it is also true in Japan.

For over 50 years the Japanese army has used metric weights successfully. In Japan I was able to buy at any store selling weights or measures, the metric weights and measures. The Japanese "shaku" differs from all American measures, and is divided into 10 divisions of approximately 30 millimeters each.

In India in 1910 I was surprised to find that the "ser," the metric ser, was used, for instance, on the railroads, and I was entitled to 40 ser of baggage. I was told that the ser was 2 pounds, 400 grains, or approximately 1 kilogram.

In Egypt I found that the signs along the roads were for motorists to slow down to a given number of kilometers. This was due to the fact that the French had first surveyed Egypt and the British had later continued those surveys.

In Cairo I visited the government building and inquired of several of the British engineers as to whether or not they preferred the metric system. The typical response of, "Well, rather," was what I heard.

It has occasionally been said that the fact that the Whitworth thread is used in such countries as Belgium indicates that systems other than the metric system are used in Europe. I have here a report, etc., which perhaps you might care to have put in the record, containing copy of a report where the Whitworth thread is mentioned. If you will notice, this Whitworth thread, having an angle of 55 degrees, was originated in England.

The CHAIRMAN. I doubt the advisability of placing such material as that in the record. It is not just what we are after in this hearing. This discussion is informal and need not be reported.

(Informal discussion ensued which was not recorded by the reporter.)

The CHAIRMAN. Proceed, Mr. Richards.

Mr. RICHARDS. Mr. Monohan, of the Moneyweight Scale Co., recently returned from South America. He found that on at least two occasions British representatives of commercial houses were using the metric system in their dealings with South American Republics, and advised him, confidentially, not to use the metric system in their dealings.

Here is a map of the United States with the new scale of 1 to 1,000,000. This particular sheet [indicating] is the sheet for Boston and its vicinity, No. North K 19. Take, for instance, the distance from Worcester to Boston. As the scale on the map is from 1 to 1,000,000, 1 millimeter on this map represents 1 kilometer in actual distance. As the measurement of the distance on the map from Worcester to Boston is 59 millimeters, the distance from Worcester to Boston is actually 59 kilometers.

That is merely one help to geography. When children are learning geography they should study it in a system where they can pick out a distance, and as soon as they have measured that distance they know right away what the distance is in kilometers.

I would like also to call your attention to the fact that all soundings on this map, gotten out by the United States Government, are in meters, and following the meters are brackets in fathoms. But this map, following the National Pharmacopœa and Formula, is another step of American practice, being settled on metric terms.

Not only has the Government been using the metric system but the various national assocaitions have to use it to keep in touch with their members. May I call your attention to the list of members of the National American organizations which are urging the gradual standardization of American weights and measures?

The CHAIRMAN. That already has been put in the record.

Mr. RICHARDS. Here is a list of chamber of commerce members that have indorsed the metric system.

The CHAIRMAN. Do you want this in?

Mr. RICHARDS. Yes, sir. That shows members of large United States chambers of commerce.

The CHAIRMAN. Very well.

(The paper referred to is as follows:)

LIST OF MEMBER ORGANIZATIONS, CHAMBER OF COMMERCE OF THE UNITED STATES, WHICH HAVE GONE ON RECORD IN FAVOR OF METRIC STANDARDIZATION.

Chamber of Commerce, Andalusia, Ala.
Huntsville and Madison County Chamber of Commerce, Huntsville, Ala.
Board of Trade, Tuscaloosa, Ala.
Warren District Commercial Club, Bisbee, Ariz.
Chamber of Commerce, Nogales, Ariz.
Chamber of Commerce, Tucson, Ariz.
Chamber of Commerce, Blytheville, Ark.
Business Mens' Club, Fort Smith, Ark.
Business Mens' Club, Van Buren, Ark.
Chamber of Commerce, Alhambra, Calif.
Chamber of Commerce, Arcata, Calif.
Bakersfield Civic Commercial Association, Bakersfield, Calif.
Chamber of Commerce, Berkeley, Calif.
Chamber of Commerce, Concord, Calif.
Board of Trade, Fullerton, Calif.
Board of Trade, Hanford, Calif.
Chamber of Commerce, Lindsay, Calif.
Chamber of Commerce, Los Angeles, Calif.
Southern California Wholesale Grocers' Association, Los Angeles, Calif.
Chamber of Commerce, Oakland, Calif.
Chamber of Commerce, Palo Alto, Calif.
Chamber of Commerce, Redding, Calif.
Chamber of Commerce, Riverside, Calif.
Chamber of Commerce, San Diego, Calif.
California Wholesale Grocers' Association, San Francisco, Calif.
Foreign Trade Club of San Francisco, San Francisco, Calif.
Holland-American Chamber of Commerce, San Francisco, Calif.
Chamber of Commerce, San Jose, Calif.
Chamber of Commerce, Santa Ana, Calif.
Chamber of Commerce of Santa Barbara County, Santa Barbara, Calif.
Chamber of Commerce, Santa Rosa, Calif.
South San Francisco Chamber of Commerce, South San Francisco, Calif.
Chamber of Commerce, Vallejo, Calif.
Commercial Association, Boulder, Colo.
Chamber of Commerce, Colorado Springs, Colo.
Commercial Club, Fort Collins, Colo.
Chamber of Commerce, Greeley, Colo.
Commercial Association, Longmont, Colo.
Trinidad (Las Animas County) Chamber of Commerce, Trinidad, Colo.
Chamber of Commerce, Greenwich, Conn.
Chamber of Commerce, New London, Conn.
American Drug Manufacturers' Association, Washington, D. C.
Box Board Manufacturers' Association, Washington, D. C.
National Drug Trade Conference, Washington, D. C.
United States Sugar Manufacturers' Association, Washington, D. C.
Apalachicola Chamber of Commerce, Apalachicola, Fla.

Commerce Club, DeLand, Fla.
Chamber of Commerce, Kev West, Fla.
Chamber of Commerce, Lake Worth, Fla.
Chamber of Commerce, Melbourne, Fla.
Chamber of Commerce, Miami, Fla.
Chamber of Commerce, Orlando, Fla.
Chamber of Commerce, West Palm Beach, Fla.
Chamber of Commerce, Gainesville, Fla.
Lagrange-Troup County Chamber of Commerce, Lagrange, Ga.
Commercial Club, Lewiston, Idaho.
Chicago Laundry Owners' Association, Chicago, Ill.
The Four Ones, Chicago, Ill.
Millinery Jobbers Association, Chicago, Ill.
National Association of Box Manufacturers, Chicago, Ill.
National Association of Loose Leaf Manufacturers, Chicago, Ill.
National Association of Retail Druggists, Chicago, Ill.
National Manufacturers of Soda Water Flavors, Chicago, Ill.
National Refrigerator Manufacturers' Association, Chicago, Ill.
Women's Association of Commerce, Chicago, Ill.
Chicago Heights Chamber of Commerce, Chicago, Ill.
Chamber of Commerce, La Salle, Ill.
Illinois Valley Manufacturers' Club, La Salle, Ill.
Commercial Club, Liberty, Ill.
Chamber of Commerce, Ottawa, Ill.
Illinois Wholesale Grocers' Association, Peoria, Ill.
Retail Lumber Dealers' Association of Indiana, Crown Point, Ind.
Chamber of Commerce, Fort Wayne, Ind.
Business Men's Association, Greenfield, Ind.
Indiana Wholesale Grocers' Association, Indianapolis, Ind.
Chamber of Commerce, Lebanon, Ind.
Cass County Chamber of Commerce, Logansport, Ind.
Chamber of Commerce, Michigan City, Ind.
Chamber of Commerce, Wabash, Ind.
Fort Dodge Commercial Club, Fort Dodge, Iowa.
Marshalltown Club, Marshalltown, Iowa.
Association of Commerce, Muscatine, Iowa.
Commercial Club, Ottumwa, Iowa.
Chamber of Commerce, Emporia, Kans.
Commercial Association, Independence, Kans.
Commercial Club, Wellington, Kans.
Chamber of Commerce, Auburn, Me.
American Wood Preservers Association, Baltimore, Md.
Merchants & Manufacturers Association, Baltimore, Md.
Chamber of Commerce, Salisbury, Md.
Board of Trade, North Attleboro, Mass.
Webster-Dudley Chamber of Commerce, Webster, Mass.
Chamber of Commerce, Ann Arbor, Mich.
Community Association, Charlotte, Mich.
Board of Commerce, Flint, Mich.
Association of Commerce, Houghton, Mich.
Chamber of Commerce, Mount Pleasant, Mich.
Chamber of Commerce, Niles, Mich.
Commercial Club of Fergus Falls, Fergus Falls, Minn.
Northern White Cedar Association, Minneapolis, Minn.
National Tent & Awning Manufacturers, St. Paul, Minn.
Chamber of Commerce, Greenwood, Miss.
Chamber of Commerce, Chillicothe, Mo.
Chamber of Commerce, Joplin, Mo.
American Wholesale Garment Association, St. Louis, Mo.
National Ornamental Glass Manufacturers' Association of the United States and Canada, St. Louis, Mo.
St. Louis Wholesale Grocers' Association, St. Louis, Mo.
Chamber of Commerce, Butte, Mont.
Chamber of Commerce, Chinook, Mont.
Chamber of Commerce & Agriculture, Glasgow, Mont.
Retail Merchants' Association of Montana, Helena, Mont.
Chamber of Commerce, Lewistown, Mont.
Chamber of Commerce, Miles City, Mont.

Chamber of Commerce, Red Lodge, Mont.
Community Club, Reed Point, Mont.
Nebraska Manufacturers' Association, Lincoln, Nebr.
Manufacturers' Association, Omaha, Nebr.
Community Service Club, Ord, Nebr.
Chamber of Commerce, Reno, Nev.
Chamber of Commerce, Mays Landing, N. J.
Chamber of Commerce, Paterson, N. J.
Chamber of Commerce, Perth Amboy, N. J.
Chamber of Commerce, Point Pleasant, N. J.
Woodbine Board of Trade, Woodbine, N. J.
Chamber of Commerce, Ballston Spa, N. Y.
Chamber of Commerce, Mount Vernon, N. Y.
American Specialty Manufacturers' Association, New York City.
Associated Motion Picture Advertisers (Inc.), New York City.
Association of American Wood Pulp Importers, New York City.
Associated Flower & Fancy Feather Manufacturers of America, New York City.
Bronx Board of Trade, New York City.
Franco-American Board of Commerce & Industry, New York City.
Furniture Manufacturers' Association of New York, New York City.
Harlem Board of Commerce, New York City.
Italian Chamber of Commerce in New York, New York City.
Millinery Chamber of Commerce, New York City.
Music Industries Chamber of Commerce, New York City.
National Association of Clothiers, New York City.
National Association of Electrical Contractors & Dealers, New York City.
National Association of Motion Picture Industry (Inc.), New York City.
National Shoe Wholesalers' Association of the United States, New York City.
National Wholesale Druggists' Association, New York City.
National Wholesale Grocers' Association of United States, New York City.
New York Lumber Trade Association, New York City.
New York Wholesale Grocers' Association, New York City.
Norwegian American Chamber of Commerce (Inc.), New York City.
Swedish Chamber of Commerce, New York City.
Tubular Plumbing Goods & Tank Fittings Exchange, New York City.
North Dakota Retail Merchants' Association, Fargo, N. Dak.
Commercial Club, Grand Forks, N. Dak.
Association of Commerce, Minot, N. Dak.
Chamber of Commerce, Akron, Ohio.
Chamber of Commerce, Athens, Ohio.
Mirror Manufacturer's Association, Cincinnati, Ohio.
Chamber of Commerce, Columbus, Ohio.
Southern Ohio Coal Exchange, Columbus, Ohio.
Sewing Machine Manufacturers' Association, Dayton, Ohio.
Chamber of Commerce, East Liverpool, Ohio.
Chamber of Commerce, East Palastine, Ohio.
Chamber of Commerce, Hamilton, Ohio.
Chamber of Commerce, Mansfield, Ohio.
Chamber of Commerce, Middletown, Ohio.
Chamber of Commerce, Bartlesville, Okla.
Chamber of Commerce, Mangum, Okla.
Chamber of Commerce, Poteau, Okla.
Commercial Club, Bend, Oreg.
Commercial Club, Dallas, Oreg.
Board of Trade, Easton, Pa.
Chamber of Commerce, Lebanon, Pa.
Commercial Museum, Philadelphia, Pa.
Pa., N. J. & Del. Wholesale Grocers Association, Philadelphia, Pa.
Philadelphia Bourse, Philadelphia, Pa.
American Warehousemen's Association, Pittsburgh, Pa.
Chamber of Commerce, Pottsville, Pa.
Board of Trade, Scranton, Pa.
Chamber of Commerce, Titusville, Pa.
Chamber of Commerce, Tyrone, Pa.
Chamber of Commerce, Rock Hill, S. C.
Chamber of Commerce, Mitchell, S. D.
Commercial Club, Pierre, S. D.

Southern Industrial Insurer's Conference, Nashville, Tenn.
Galveston Cotton Exchange & Board of Trade, Galveston, Tex.
Chamber of Commerce & Business Men's Club, San Antonio, Tex.
Chamber of Commerce, Victoria, Tex.
Chamber of Commerce, Ogden, Utah.
Commercial Club and Chamber of Commerce, Salt Lake City, Utah.
Commercial Club, Camas, Wash.
Chamber of Commerce & Commercial Club, Seattle, Wash.
Chamber of Commerce, Morgantown, W. Va.
Association of Commerce, Green Bay, Wis.
Chamber of Commerce, Marshfield, Wis.
Association of Commerce, Sheboygan, Wis.
Association of Commerce, Waukesha, Wis.
Chamber of Commerce, Wisconsin Rapids, Wis.
Chamber of Commerce, Casper, Wyo.
Chamber of Commerce, Anchorage, Alaska.
Commercial Club, Fairbanks, Alaska.
Chamber of Commerce, Honolulu, Hawaii.
Chamber of Commerce of the Philippine Islands, Manila, P. I.
Chamber of Commerce of the United States of America, Buenos Aires, Argentine.
American-Belgian Chamber of Commerce, Bruxelles, Belgium.
American Chamber of Commerce for Brazil, Rio de Janeiro, Brazil.
American Chamber of Commerce for Italy, Milan, Italy.
American Chamber of Commerce of Italy, Naples, Italy.
American Chamber of Commerce of Tampico, Tampico Tamps, Mexico.
American Chamber of Commerce for Spain, Barcelona, Spain.

Mr. RICHARDS. Here is a group of resolutions and letters from Government officials all indorsing the metric system.

The CHAIRMAN. Very well; that may go in.

(The papers referred to are as follows:)

"The following resolution was adopted unanimously by the International Brotherhood of Electrical Workers on September 29, 1921:

"'*Resolved*, That the International Brotherhood of Electrical Workers in convention assembled recommends the enactment of legislation that will secure the advantages of the general use of metric weights and measures for the people of the United States, and that we also indorse H. R. 10 and S. 2267, a bill calling for the commercial use of the metric system by the people of the United States after a transition period of 10 years.'"

Mr. RICHARDS. Would you be interested in a letter from A. D. Lasker, indorsing the metric system? Would you be interested in that?

The CHAIRMAN. It may go in.

(The letter referred to is as follows:)

UNITED STATES SHIPPING BOARD,
Washington, July 7, 1921.

Mr. W. MORTIMER CROCKER,
Washington, D. C.

DEAR SIR: I beg to acknowledge the receipt of your letter of July 2 for my views relative to the adoption of a metric system, the contents of which have been carefully noted.

I note your statement that Japan has adopted the metric system, and that the Chinese minister of commerce can, at any time, place the nation on the metric basis. This is evidence of the fact that the use of the metric system is continually increasing, and I feel that sooner or later the United States will be compelled to adopt this system.

The metric system is, in my opinion, a necessary reform, and must be adopted by the United States within the future in order that our business operations may be conducted in an intelligent way, and I feel that the sooner its adoption is brought about in this country the better it will be for the country.

Very truly, yours,

A. D. LASKER, *Chairman.*

Mr. RICHARDS. Here is a resolution which was unanimously passed at the twenty-fifth annual convention of the National Congress of Mothers and Parent Teacher Associations, held in Washington in April of this year. They have a membership of 250,000.

The CHAIRMAN. Very well.

(The resolution referred to is as follows:)

WASHINGTON, D. C., *April 29, 1921.*

The following resolution was unanimously passed at the twenty-fifth annual convention of the National Congress of Mothers and Parent-Teacher Associations held in Washington, D. C., April 26 to 29, inclusive, 1921:

Whereas it is generally agreed that the present system of weights and measures used in the United States is cumbersome and a hindrance to the American school children; and

Whereas American educators are practically unanimous in favoring the replacement of the present system with the international metric system of weights and measures; and

Whereas statistics show that practically one year in the school life of every American child could be saved if the decimal metric system of weights and measures were taught instead of the present system; and

Whereas the enormity of loss in time and money can be somewhat appreciated when it is remembered that, according to the statistics of the United States Bureau of Education, there are about 22,000,000 public school children in our country being educated at a cost of not less than $800,000,000 per year; and

Whereas the metric system of weights and measures is the simplest system yet devised and used almost exclusively in 36 nations of the world; Now, therefore, be it

Resolved, That the National Congress of Mothers and Parent-Teacher Associations favor the enactment of legislation calling for the complete adoption of metric weights and measures in the best way for all concerned.

(The National Congress of Mothers and Parent-Teacher Associations comprises a membership of over 250,000, and is organized in 40 States of the Union.)

Mr. RICHARDS. The medical profession is united by membership in the American Metric Association, and here is a statement by Dr. W. W. Keen, ex-president of the American Medical Association. It refers to doctors and their work throughout the country.

The CHAIRMAN. Very well.

(The statement referred to is as follows:)

PHILADELPHIA, *October 7, 1921.*

The SENATE COMMITTEE ON MANUFACTURERS,
Washington, D. C.

GENTLEMEN: I beg leave, as an ex-president of the American Medical Association, of the American Philosophical Society, and of the College of Physicians of Philadelphia, to support most heartily the Britten-Iadd bill, H. R. 10 and S. 2267.

I wish to call attention to the fact that the American Medical Association supports heartily the metric system by making that the standard in the text of articles in their journals. For convenience, at present, they insert also the corresponding English measures.

It is only by getting people in all departments of life to think in meters, liters, and grams, instead of our archaic system at present in use, that we can eventually hope to make it universal. The only obstacle to the universal use of the metric system is the position of Great Britain and the United States.

The present time is eminently favorable to the introduction of the metric system in this country and in Great Britain as well. Two million of our soldiers have been in France and are familiar with the kilometer, the meter, the kilogram, the metric ton and other metric weights and measures. In addition, a very large number of our manufacturers have been constructing locomotives, making ammunition, and very many other kinds of manufactures by the metric system.

My friend Mr. Vauclain, president of the Baldwin Locomotive Works, has told the American Philosophical Society publicly that his men learned to build locomotives on the metric system in an hour and a half, and that they make fewer mistakes in the metric system than by the use of the English system.

I very sincerely hope that this bill will be passed.

Yours, very truly,

W. W. KEEN.

(Emeritus Professor of Surgery, Jefferson Medical College, Philadelphia; ex-president American Medical Association; ex-president International Congress of Surgery Paris, July, 1920.)

Mr. RICHARDS. The Army and Navy are represented here in this paper that I will submit—Admiral Jane and Col. Reese. At the convention of the World Metric Standardization Council those two men appeared, representing the Army and Navy,

and stated their views with regard to the metric system. A summary of their address is included in that magazine [indicating] and other papers.

The CHAIRMAN. Is it your request that these addresses go in the record?

Mr. RICHARDS. Not unless you care to put in parts of the addresses of Admiral Jane and Col. Reese.

(After informal discussion which the reporter was directed not to record.)

The CHAIRMAN. I do not think we want to put all that in. These papers and magazines can be left in the custody of the clerk of the committee, so that they will be available to members of the committee and the public.

Mr. RICHARDS. Very well. Would you care to have in Admiral Sim's personal letter?

The CHAIRMAN. Very well.

(The letter referred to is as follows:)

NAVAL WAR COLLEGE,
Newport, R. I., July 7, 1921.

DEAR SIR: Referring to your letter of July 2, I need not say, I am sure, how much I am interested in any measure or movement which will tend to bring the English-speaking peoples into closer and more intimate relations and understanding; and to this end it would seem to me that the introduction of the metric system as a common system of weights and measures would exert very considerable influence in this direction.

As to the many advantages of an international standardization, based upon the decimal system for all weights and measures, it is generally understood that this would greatly simplify, facilitate and reduce the expense of making plans and calculations, and of conducting commercial transactions.

It therefore seems to me that, from every point of view, the advantages of the adoption of the system in question would greatly outweight the inconvenience and expense involved in making the change.

Very sincerely, yours,

WM. S. SIMS,
Rear Admiral, United States Navy.

Mr. W. MORTIMER CROCKER,
World Metric Standardization Council, Washington, D. C.

Mr. RICHARDS. I would like to submit a letter from the Automatic Electric Co.—that is, following the others—outlining their reasons for changing over to the metric system.

The CHAIRMAN. Very well.

(The letter referred to is as follows:)

AUTOMATIC ELECTRIC CO.,
Chicago, Ill., May 9, 1921.

HOMER L. FERGUSON,
President Newport News Shipbuilding & Dry Dock Co.,
Newport News, Va.

DEAR SIR: We are informed that there has been introduced into Congress a bill which is intended to bring about the practical use of the metric system in this country.

The metric system is needed by the industries of this country, and we hope that the bill will pass for the following reasons:

1. The present system of weights and measures is nondecimal and places upon us a burden of calculations and tabulated data which the metric system removes and a ceaseless vigilance against error due to the composition of the units which the metric system greatly reduces.

2. The metric system is made up of units which are naturally related to each other by decimal relations—the system is completely homogeneous. It reduces the mental labor in measuring, weighing, computing, and recording and reduces the probability of error.

3. Our research department has been using the metric system exclusively for a number of years, both in research and in design, and has found that it is vastly superior to the old system.

4. We propose, as soon as it can reasonably be done, to convert our entire factory to the metric system, not changing any of our dimensions, but simply measuring them in metric units. We have surveyed our factory by departments, to see what changes are necessary, and are surprised at the small cost which it involves.

5. We employ 3,000 people and are growing.

6. The adoption of the metric system by the country will be a distinct help to us in our own movement toward greater efficiency. However, we are going ahead with our own preparation.

7. The proposed law provides for the introduction of the metric system gradually over a period of 10 years. It is certain that as soon as the law is passed, many concerns will convert to metric at once, thereby assisting the general public in beginning its use.

8. We have experimented with teaching the metric system to people and have found that it is picked up with great ease and speed.

9. A very large part of the American people are already familiar with the metric system consisting of former natives of European countries, soldiers who served during the World War, as well as engineers, scientists, and students.

For these reasons we urge you as member of the committee on the metric system, to do all in your power to secure the passage of the bill.

Yours, truly,

A. E. KEITH, *Vice President.*

Mr. RICHARDS. Have you any questions?

The CHAIRMAN. I do not think you have approached the bill. Have you read this bill, Mr. Richards?

Mr. RICHARDS. I have; yes, sir.

The CHAIRMAN. Do you think it is practical?

Mr. RICHARDS. I think it is a practical, conservative measure.

The CHAIRMAN. To force upon the people?

Mr. RICHARDS. I would not say it was forcing. I would say as metric weights and measures are used more and more, they will appeal to the people so strongly, will save so much time and money, that it will not be a matter of forcing the metric system upon the people. Mr. Thomas A. Edison called at an exhibit that we had in New York City the early part of this month. His only criticism of the bill was this—he said these words: "I want you to force me to use the metric system in my factory," his point being that this bill did not go far enough, because there were other people that he dealt with who would not use the metric system until they were advised to by the Government.

That is the way the metric system has been brought in, by having the Government say, "At such and such a time it is our opinion that it is in the interest of the country to start in and use the metric system."

Mr. Edison's opinion is that this bill is all right, but it might even go further and compel the metric system to be used throughout factories. We do not as an association advise that, but at the same time, to show the conservatism of this bill, I take the opportunity of mentioning Mr. Edison's opinion.

The CHAIRMAN. It is quite apparent that apothecaries, manufacturers, and engineers, over the country, are in favor of it, but they are a very small per cent of the great mass of people. Of what advantage is this system to the average individual engaged in business; and how long would it take such an individual to adopt the system, and would he do it graciously? Those are practical questions. I can see the advantage to the factory man, to the man dealing with chemicals and drugs, and to engineers. We are forcing a great change upon the public for a few people who would benefit by the change. It is from that standpoint that I want some discussion of the subject.

Mr. RICHARDS. I have three children of my own, and I am engaged now in teaching those children to count, how to use numbers, and how to weigh and measure. I find as an engineer that the work would be far simpler if I had the way the Italians have, as illustrated in an address by Madame Montesori bef re the American Metric Association at its meeting in 1916. She outlined the system by which she educated young Italians. They learned how to count by tens. They learned that there were 100 centimeters in a meter, and they learned how to measure distances. They then passed on. The system appealed to them. It was original and they liked it. They did not acquire the distaste for mathematics that a boy does when he has to memorize, for instance, that there are 1,728 cubic inches in a cubic foot, and similar facts that are only confusing.

Also in this connection, since it has been referred to, I want to call attention to a book issued by the National Tube Co.

The CHAIRMAN. They are manufacturers?

Mr. RICHARDS. They are pipe manufacturers. The National Tube Co. issued a book, which contains some 700 pages. This book is filled with such information as is instanced by the following illustration, out of hundreds of similar ones contained in the contents of the book, that illustrates the saving effected by the use of metric weights and measures. On pages 366 and 367 tables are given, decimals of a foot, to the sixty-fourth of an inch. That is a table which has to be used by people working in a drafting room and people working in a store. If they have to buy pipe they find, "We have got to buy so many feet of pipe."

The relation between feet and inches is given in a long table. Another instance is a table in page 369, giving the actual sizes of different wires and sheet-metal gauges.

If I might make this comment, as a former employee of the New York-Edison Co., I knew and had good reason to know that the public did not know what they were paying for. For a considerable time I was in the meter department and knew that the public were confused and were not informed in regard to what they were buying, how they were buying it, and what they were paying for it.

To add to this confusion there are seven different wire-gauge tables noted here. That prohibits the average man from knowing what the size of a wire meant. If you call for a 2-millimeter wire, any intelligent man can understand you mean it is a wire having a diameter of 2 millimeters. If, however, you call that wire a No. 35 Stubbs gauge wire, or if you call it a No. 12 Brown & Sharp wire, you inhibit the average man from understanding what is meant.

During my time with the Edison Co. I bought a wire gauge, a simple little instrument [indicating]. It apparently does not cost much. That is a gauge which at that time sold for $2.50. This was only one company, and there are thousands of those sold. If, as I say, we adopt the simple international method of giving direct measurements for wires we knock the bottom out of certain special privileges. I outline that as a theory only.

May I ask if any proof is needed of that theory?

The CHAIRMAN. What are the privileges you would knock out?

Mr. RICHARDS. The privilege of manufacturing and selling a gauge that can be be replaced by a micrometer or simple measuring instrument, and doing away with an unnecessary piece of brain fatigue for the American public. In every contract for wiring a house the wires are numbered according to some special wire gauge, and the man who signs the contract is as a rule ignorant in regard to the actual size of the wire he is getting.

Is that a practical point, sir, that will appeal to laymen?

The CHAIRMAN. I do not know that I am called upon to answer questions.

I want a discussion of this subject from the standpoint of what it means to a man out in North Dakota, for instance. You are always getting back to the technique of the thing, referring to draftsmen, factory men, etc., and you have not answered the question I propounded.

Mr. RICHARDS. Yes; I was coming back to that.

The CHAIRMAN. I believe the impressionable ground found in the young mind is the place to start. That will take a generation. That is not this bill. This bill is effective 10 years from its passage. At that time it will have to be accepted and used by everybody, not just your three children, but by the adult people of this country, not along the factory man or the drug man, but the farmer in Wyoming and North Dakota, in Nebraska and Kansas, by the storekeeper, the wage earner in Washington and elsewhere, and the factory hands. I think quite as much of those people as I do of engineers.

Mr. RICHARDS. More.

The CHAIRMAN. Do you think as a practical thing we could pass a law so that it would be adopted graciously by the great mass of the people of this country, irrespective of age?

Mr. RICHARDS. I think there would be a few, a number of men who would discuss it and talk about it, and find that in buying, for instance, a 5-pound bag, they would buy a bag of so many kilos. In different ways they would get used to speaking of kilos. Especially around the border of the United States they would speak of kilos and know they were speaking in an international language, and have no trouble with Mexico in regard to weights and measures. All along the northern border instead of the liter we have the quart, which is illegal in Canada, and the Canadian quart is illegal here.

All that would be smoothed out. Not only that, but our export trade would be smoothed out. I am inclined to believe that the experience of other countries has been that the people that at first think it is going to be a hardship to go to the store and order, for instance, 50 grams instead of 2½ ounces of pepper or salt, or whatever they are ordering, will find that it is a convenience rather than a hindrance to any practical negotiations.

The CHAIRMAN. Let me propound to you one or two propositions. One way of accomplishing this thing would be for the States to adopt laws uniform in character imposing this system upon the people of the State.

Mr. RICHARDS. Why not have a Federal law?

The CHAIRMAN. And accomplish this through the process of education. As a farmer I do not believe the Constitution would permit the Government to dictate to the States what they should teach in the schools.

Mr. RICHARDS. No.

The CHAIRMAN. That is what I am discussing. Some lawyers will not agree with me, but speaking as a farmer I believe that is true. If the States would adopt uniform

laws, requiring the metric system to be taught in the schools, and if it were taught, either to the exclusion of the present system or in conncetion with it, in the process of 25 years you would have a new generation accepting it, would you not, educated and trained to it; they would think in this system and not in the present one. Now, that is one way.

Another way would be to enforce this system in all Governmental activities, letting the Government take the initiative in this matter. That would naturally set an example for all of us to follow. That is another way to approach it.

The third way is by this bill, and I am not saying it is not the best way to compel the people under all circumstances, in the face of the lack of education in some sections of the country, in view of the age that men attain when they do not readliy grasp new problems and new difficulties, saying, "In 10 years you must take this whether you want it or not."

I want to know as a practical matter, looking at it from the practical standpoint of the legislator, which method is the best. Or have you something else to offer as a substitute?

Mr. RICHARDS. Your third solution of the problem is the best solution, to my mind, because there you get the team work that we need; you get the cooperation of the people who have requested it, of the 103,000 and odd people who have sent in this petition and requested you and other members of Congress to pass such legislation.

The CHAIRMAN. That is not an answer at all, if I may be pardoned for saying so. Propaganda is one thing.

Mr. RICHARDS. Yes.

The CHAIRMAN. You have not reached the masses yet by any evidence that has been submitted here. I do not suppose there are five farmers in North Dakota that know anything about this system.

Mr. RICHARDS. It is taught in all the schools in North Dakota, is it not?

The CHAIRMAN. If so, it is the only State I know of. I mention that State because my good friend, Senator Ladd, is here, and who has introduced this bill with the idea, and a very laudable one, to change around to this system. I can see the advantages of it, at some time and some place, as I can see the advantage of an international tongue or an international dollar. Those things are all along the same line of thought.

But the problem is, how to approach these things. Must it come through evolution or must it come through enforcing legislation, and if so, how? That means more to me than all the tables you can present, because you can get the tables in these books anywhere.

Mr. RICHARDS. Not in the European books; not in the books used in South America.

The CHAIRMAN. I am speaking about the general tables of the metric system.

Have you anything further you care to say?

Mr. RICHARDS. Yes. I would like to take up the matter of the objection to the metric system. That is the theory I outlined of the objection to the metric system. Let us see how it works out in practice. In the previous hearings Mr. Frederick A. Halsey appeared before the committee and gave his testimony against the measure.

The CHAIRMAN. When were those hearings held?

Mr. RICHARDS. They were in 1906. They were hearings before the Committee on Coinage, Weights, and Measures of the House of Representatives on H. R. 93, of the Fifty-ninth Congress, first session. The first testimony is by Mr. Frederick A. Halsey.

Shortly after the organization of the American Metric Association, Mr. Frederick A. Halsey called at the office of the American Metric Association and made this statement, which he has publicly acknowledged: "We have killed the metric system before and we will kill it again." We asked Mr. Halsey who "we" were. We learned that Mr. Henry D. Sharpe, treasurer of Brown & Sharpe, had called together in New York City a number of men to fight the metric system, and had himself contributed $1,000 to Mr. Halsey. Mr. Halsey had the cooperation of Mr. L. D. Burlingame, also of Brown & Sharpe, who later succeeded him as secretary of his organization. Mr. L. D. Burlingame was succeeded in turn by Mr. C. C. Stutz, formerly of the Brown & Sharpe Manufacturing Corporation.

Mr. F. A. Halsey has written to the American Metric Association, stating that Mr. S. S. Dale and himself had an entire right to receive, and were justified in accepting, money for their work—"We have killed the metric system before and we will kill it again." We do not question their right to accept money for knocking the metric system——

The CHAIRMAN. What has that to do with this bill?

Mr. RICHARDS. It has a good deal to do, sir, for this reason: We want to have these facts brought out, to contradict these statements and show their source. We have great difficulty in getting at the opposition to the metric system.

The CHAIRMAN. It has not developed yet, if there is anything.

(After informal discussion which the reporter was directed not to record:)

Mr. RICHARDS. If you have no further questions I will not take up your time.

The CHAIRMAN. Did you want to discuss any other part of the legislation?

Mr. RICHARDS. As far as the American Metric Association is concerned we would be glad to make any modifications in this bill that you Senators would recommend. We want to help in any way we can. We feel that we have worked up a public opinion that is strongly in favor of the metric system as a whole. We know of no intelligent people who have looked into the matter who do not believe this is the best method to bring it in, for the welfare of the country. We have heard for years the other methods criticized as being unfair to the Government, in having the Government start it without the people. It affects the purchasing departments of the Government.

On the other hand, teaching it only in the public schools, and not having it in practical use, we have found that we do not make much headway. Where we have made headway is in such instances as when the Goodyear Tire & Rubber Co. changed over and used the metric system. They have as many as 4,000 employees, and when they put it in their factory it was accepted and used with enthusiasm.

One more point, as to the way the metric system is now being taught in most schools, using such a table as this, where the actual measures are used. One difficulty we have had is with people who do not appreciate or understand the metric system and have thought it confusing, whereas when dealing with a machine shop you use millimeters only, having diagrams with millimeters on the drawings, giving all the facts that are necessary; the carpenter uses the centimeter; the woman uses centimeters and meters, the number of yards corresponding to the number of meters; the grocery store weighs out in kilos instead of pounds and ounces.

Department stores, such firms, for instance, as Wanamaker and as T. Eaton, the largest place in Canada, have expressed themselves in favor of the metric system as soon as they can help to bring it in, but they can not start themselves and use the metric system until we get such a bill as this through. We anticipate general approval of the passage of this bill and a great revival and increase of our dealings and business with South America, Europe, China, and Japan, countries that want us to use the metric system and will trade with us more readily than they would in the old system.

The CHAIRMAN. Did your association prepare this bill?

Mr. RICHARDS. No.

The CHAIRMAN. It is solidly back of its enactment, is it?

Mr. RICHARDS. Yes, it is solidly back of its enactment.

The CHAIRMAN. Does this depart from other bills in which you have shown an interest?

Mr. RICHARDS. Yes.

The CHAIRMAN. Do you believe this is the last and best product?

Mr. RICHARDS. There may be modifications that would appeal to you gentlemen that we would be very willing to accept, but the vital thing is to pass some legislation, giving ample time for it to become effective, leaving the details to be worked out in your discretion, but making it known that within 10 years America will follow the other countries of the world and come in on a simple international basis.

The CHAIRMAN. How long do you think it would require the average individual, with a common school education, to become familiar with and capable of handling this system in all dealings?

Mr. RICHARDS. That depends on the work he is doing. I am inclined to believe that in any profession one week would be ample time in which to learn the uses, the every-day uses, of the metric system for that profession.

The CHAIRMAN. Do you think that a man living in the country, out in the West, raising corn—that is the big crop there—and wheat, or a man on the ranges of Wyoming raising cattle, dealing generally with business men in the buying of farm implements and the selling of his produce, and also concerning matters of transportation, having dealings at the bank, with a common country school education, 55 years of age, who has spent most of his time at manual labor rather than study, could get a practical knowledge of this system within a week?

Mr. RICHARDS. I do.

The CHAIRMAN. He is a whole lot smarter than many legislators I know, including the chairman.

Mr. RICHARDS. May I ask, sir, if these prices you are speaking of do not change from time to time, and where you are dealing in metric terms, which is almost the same as the long ton, between the long ton and the short ton, where you are dealing in those commodities in which a change in the price is probable at any time, the fact that you are putting this on an international basis, doing away with the long ton and the short

ton, and using one unit for the world, will be a change that will facilitate your transaction?

You know you buy coal in carload lots by the long ton, it is sold to you by the retailer in short tons, and in different ways there is confusion that will be straightened out when you come to this system.

The CHAIRMAN. I grant that, but you get right back to the question of its merits. Do you think that the fellow I have described could familiarize himself with this system and adopt it in a week?

Mr. RICHARDS. Take the simple things he has got to do. He has got to buy corn. Put a little table up before him for a while, so that when he buys corn for a horse he will do it in the metric system, and he will know it in a short time. The transactions a farmer has to make are comparatively simple. The young men are going to school and learning about soil analysis. They have got to work upon the percentage basis if they are going to succeed. Chemistry is taught entirely in the metric system. As they learn that system they say, "This is a simple thing; it is percentage; we understand this," and they go right along to speak in the metric system, in that way.

May I suggest such a simple illustration as this. A man has to find out the size of a bin, or he has to design a house. What scale is he going to use? The most convenient architect's scale, the most convenient civil engineer's scale, is the number of inches and the number of feet. Where you have a metric scale, with the number of millimeters to the meter you find you can write off directly very much more easily than you can by writing in fractions of an inch or foot.

When the farmer takes up that work, when he looks over the plans for a barn, he can see, "Well, this is the easy way, this is the simple method."

I want to put my services at your disposal to satisfy you and your colleagues that this is the easiest and simplest thing for the farmer, for the laborer, the men whom we are hoping indirectly to serve.

The CHAIRMAN. All right, Mr. Richards; thank you very much for your attendance and help to the committee. We will call now on Mr. Hubbard.

STATEMENT OF MR. HENRY D. HUBBARD, SECRETARY BUREAU OF STANDARDS.

The CHAIRMAN. Mr. Hubbard, kindly give to the reporter your name, address, occupation, what experience you have had in the line of work you are in, and your acquaintanceship with the metric system of weights and measures.

Mr. HUBBARD. Henry D. Hubbard, Washington, D. C. Since 1901 I have been secretary of the bureau, and recently assisting the director.

My knowledge of the metric system began in 1902 in an active way, when the first movement for the adoption of the metric system took place. But in high school and college I had been called upon to study the system. It therefore became an object of considerable interest when I entered the scientific bureau at Washington.

The letter that Dr. Brown received in regard to my being called here, stated, I think, that it was expected to discuss not merely the bill but the general subject, and with your permission I would like to take up the phase with which I am a little more familiar than——

The CHAIRMAN. We are here to discuss the bill, of course. We are not here to experiment on theories or discuss it from an academic standpoint. I would be very glad to have you approach the subject in a way that would be understood by the general run of the public.

Mr. HUBBARD. Yes; all right. I will endeavor to do it.

The CHAIRMAN. And which will be an aid to the committee, rather than in such a technical way that it frightens rather than informs.

Mr. HUBBARD. I think the thing in which the committee would really be interested would be to know, from our point of view, what a system of weights and measures must do.

The CHAIRMAN. Very well.

Mr. HUBBARD. Am I right in that?

The CHAIRMAN. Go right ahead; that is all right; yes.

Mr. HUBBARD. With that in view, if you will allow me, I will begin——

The CHAIRMAN. Very well, Mr. Hubbard.

Mr. HUBBARD. If you will allow me, I will begin by showing, in one or two specific cases, the inadequacy of our present system.

It is only fair that we should consider, first of all, what a system of weights and measures must do. The time has gone by when we are content to include under weights and measures merely the pound, the yard, and the bushel. We now measure light, heat, electricity, refrigeration, steam power, ventilation, and all the countless

properties of materials, just as carefully as formerly we measured length of fabrics or the volume of commodities. In other words, the far reaches of measurement have extended into fields which are perhaps a thousand times more difficult than the mere measuring of the volume of a parcel of grain or the measurement of a length of fabric.

At one time the foot was considered good enough if on the first Sunday of each April, I think, the first 16 men who came out from a certain church in Germany were lined up, their feet placed end to end, and those 16 men formed 16 feet, and the average was taken, and that was considered to be the standard foot for one year.

Now, modern precision has gone infinitely beyond that, and if I may use one illustration, Mr. Chairman, I would like to give the range which we must cover by measurements. The smallest unit of matter which is known is called an electron. It is the portion of the atom which is the smallest unit of matter that can exist. If I may, I would like to just put down briefly the figures which we must measure for the smallest object, and this measurement is obtained entirely in the metric system, by methods developed in the metric system, and we must do these operations because they are at the present time controlling great industries.

The CHAIRMAN. These are units of measure you are discussing?

Mr. HUBBARD. Yes.

The CHAIRMAN. And not weights?

Mr. HUBBARD. No; just measurement. At the other extreme the astronomers are measuring the largest conceivable stars, which are very much larger than our own sun.

I will put the figures down, so as to show you the range which we must cover. Then the range or variety of measurements which we must undertake is so great that we probably have in our own bureau two or three hundred different kinds of measurements, for properties which must be measured.

The farmer's unit is the bushel. In that connection I desire to put into the hands of the committee, if they have not already a copy, Circular No. 10 of the Bureau of Standards, which gives in closely tabulated form, covering six or eight pages, the actual different values of the bushel, so that the bushel is really a multiplicity of units, and no living person makes the remotest attempt to memorize those facts; it is absolutely impossible. It takes months to revise that particular publication

In the Food Administration, when they took a survey of the food supply during the war, they had to abandon the attempt to secure the statistics in terms of the bushel, and had to go to the pound.

Mr. RICHARDS. May I ask if the bushel can not be satisfactorily defined as 35 liters, which is the approximate value of the bushel, and the bushel still continue as the farmer's unit and be known as 35 liters—which will facilitate our dealings with other countries?

Mr. HUBBARD. The District of Columbia, I believe, has adopted the method of measuring commodities by weight, and that is considered the preferred form; and, as a matter of fact, that is the method by which practically all transactions in grain are conducted.

If I may be permitted, I will say that the exhibit furnished in that document is an appalling confession for any nation to make. The standard of weights and measures, according to the Constitution, is to be fixed by Congress. As a matter of fact we see the varying values given in those tables, and there are something like seven or eight fine-print tables, giving the different values of the bushel. The same commodity, in two adjoining States, will differ by as much as 15 and sometimes 30 per cent. Statistics are impossible.

Price quotations mean almost nothing, because the State may not be indicated in which those values are given, but if the State were indicated the term "bushel" would not necessarily mean the particular pounds given there, because in the State the United States bushel may be used equally with pounds. Consequently you do not know how certain statistics have been compiled. According to my belief that one document is sufficient to condemn the entire system of dry measures used in the United States.

The CHAIRMAN. Briefly, the table about which you speak covers the statutes in various States denominating how many pounds shall constitute a bushel for certain agricultural and horticultural products.

Mr. HUBBARD. Yes.

The CHAIRMAN. I know personally there is a variance in those figures, but I notice from this table, to make your testimony on it intelligible, that all the States have agreed that 60 pounds shall constitute a bushel of alfalfa.

Mr. HUBBARD. On some things they are nearly together.

The CHAIRMAN. On apples the variations run from 44 to 50 pounds, the mean average being about 48 pounds; on apple seeds all are agreed on 40 pounds; on dried

apples they run from 24 to 28 pounds; barley is practically all 48 pounds; beans are all 60 pounds to the bushel. They are the principal commodities given here.

Mr. HUBBARD. On the page following you will find the tabulation continued which gives quite a wider range. At any rate, I had not meant to more than submit the facts to the committee, showing it takes a document of 8 or 12 pages to really give the standard weights to the bushel. And when they are given it does not mean the statistics are right or that the prices quoted are in terms given there, because that is indeterminate because in many cases they are restricted to the struck bushel and in other cases to the heaped bushel.

The CHAIRMAN. Is not this overcome largely in the commerce of the country by the practice of selling by the pound?

Mr. HUBBARD. It may be, but as a matter of fact they are not sold by the pound in many cases.

The CHAIRMAN. I have a very fair knowledge of the fruit business in the West.

Mr. HUBBARD. I am speaking of the markets.

The CHAIRMAN. And we have discarded the bushel entirely. Sales are made by the pound. You never hear of prunes being sold by the bushel, you never hear of walnuts being sold by the bushel, you never hear of loganberries being sold by the bushel, you never hear of cherries being sold by the bushel; it is always the pound; the pound is the unit. That is universal throughout the country. That is a necessity imposed by the rules of commerce. So I do not think that has impeded commerce to any very considerable extent.

Mr. HUBBARD. I can only say that the prices quoted in the various exchanges are in bushels. I did not mean to enter into an argument at all on the point, but merely to submit what seems to me to be a danger from the weights and measures standpoint. Every weights and measures official would agree really that the situation is literally appalling from the standpoint of anything which you wish to mention.

The CHAIRMAN. I think, with you, that it would be better for all concerned, and for the world at large, if we had a common tongue in weights and measures; but I am interested in how we are going to bring it about.

Mr. HUBBARD. I want to go now from the dry measure to the liquid measure, and in passing I might state that our dry measures differ in every particular from the English dry measures. The English dry measures differ from the American dry measures by about 3 per cent.

To proceed to the liquid measures, we have a liquid gallon and then we have the liquid quart and the dry quart, side by side. The same thing is true in England, and the entire set of both liquid and dry measures of England and America differ. The liquid measures differ by about 20 per cent, name for name. It is very difficult to know what gallon is meant, whether the English or what.

I would like now to pass from the liquid to the metric and show that in the metric system it is quite simplified in this fashion. They take simply the tenth of your unit and that constitutes your cube for the capacity unit. That is all there is to it. It is a very simple method of deriving it. The tenth of a meter gives your unit of capacity. Fill it with water and you have the unit of weight. In other words, the whole system is given in about 8 or 10 words, fundamentally. The same measure would be used for liquid or dry, or they cube the weight if that is the preferred form in a given market. In other words, the liter has one meaning the world over, and the quart varies from country to country. Between Canada and the United States the trade therefore is embarrassed.

To refer to one more case, may I speak of the ton? The ton is a unit which has always given much confusion. The ton in the metric system is shown right here [indicating] in this white cube, which I have put together to show graphically the unit which is used in all the countries which have adopted the metric system—upward of 30.

There are two kinds of tons in the United States which are used, and these do give considerable difficulty. The term "ton" is usually used without the prefix "long" or "short." We also have references to the practice in various States concerning the ton that is extremely confusing and embarrassing. As a matter of fact, right in the District here we are supposed to have a 2,240-pound ton, but we know that 2,000 pounds is more prevalent throughout the country. The English deal more commonly with the 2,240-pound ton.

In the metric system we simply take the unit of length and cube it. We have the ton when such a cube is filled with water. So a unit cube of water gives you the ton—the cubic meter. That is used for all purposes where you measure volume.

Nothing could be simpler, and the design was to make it so simple that anybody could understand it. To show that is a fact, school children are furnished with a little rule, like this [indicating], which is picked up in ordinary drug stores that

supply school equipment for children. I picked that up at the first school-equipment store I saw, and it cost 1 cent. It gives both the English and the metric. I asked my wife a short time ago for a tape measure. She gave me a 60-inch tape measure, and on turning to the back of it I found the metric system set out.

I want to say this one thing before I speak of what a system must do, and that is we can not ignore what other countries have done and what the sciences in the world have done. All the sciences in the world, whether physics, chemistry, biology, or medicine, have adopted the metric system; that is universal. So it occupies a place in that tremendous group of human activities which, as we all know, are making the future, so far as both industry and technology are concerned.

It seems to me that we have got to take into account not only what science has done, but what other nations have done—nations having all the ranges of intelligence, from those of France and Germany to those of China and Japan. Since the war there have been five nations added to the 34 which had made it the legal system. Those nations were not compelled by any external power to adopt the metric system. They did it because they needed the best system, and we need the best system. If 37 nations have adopted it there must be a most excellent reason. If a country like China thinks it practicable and Japan recently has decided that it is practicable; if Germany adopted it immediately after the Franco-Prussian war from her conquered foe, it indicates that it is worth consideration.

I want to explain why, in my opinion, it is worthy of consideration as compared with what we might call the natural systems of weights and measures. In primitive times every locality had its own system of weights and measures. When trade became great and intercommunication increased, the separate systems came into conflict; and when a group would meet in a common market, the pound or the foot would mean nothing to them. In Germany alone there were approximately 16 different pounds and 16 different feet; and in all we have had many hundreds of specimens of both the pound and the foot.

The purpose in the founding of the metric system was to bring about not merely a national universality but an international universality. The movement began before the French Revolution, during which time the metric system was adopted. The principles were formulated many years before and they were derived from many sources. It could not be attributed to the French alone, but to the entire body of experience in weights and measures.

When the metric system was adopted they took the common ratioor unit—that is, the basis of our number system, derived from our 10 fingers—and that is the ratio that is used throughout the metric system. If you realize the design of the metric system it was intended to be the simplest attainable.

Let us see whether they attained that result. They took the fingers which gives you your unit ratio. They took the hand which is approximately one-tenth of the unit of length. Its width is practically 4 inches, which is the ordinary hand used in measuring horses and is practically one-tenth of a meter. Cube that and you have the unit of volume. Fill that with water, and you have the unit of weight. That is the essence of the design of the metric system.

There have been somthing like five or more thousand different units of weights and measures, and the simple units have been designed for the utmost simplicity to get just as close to mere numbers as it is possible to make them. In fact, Madame Montisori uses the metric models in her work of teaching numbers; she uses the metric models to teach numbers instead of the reverse, and her children are therefore familiar with the metric units.

The United States inherited at the time of the colonies the old English weights and measures. England has since adandoned portions of them and reconstructed her measures to suit herself and without conferring with the United States. The troy pound, of which I have a copy here [indicating] was used for many years in regulating coinage. England abandoned the troy pound. England also abandoned the bushel, which he had, and all the dry measures that go with it; she abandoned the liquid gallon and the quart and the liquid measures that go with it, and established a system of her own.

We were therefore in a sense independent, not only politically but in many respects, in the matter of weights and measures. In length measures we were in the most serious condition, because we had no fundamental standard which had been adopted by Congrress or fixed in any way. But we inherited from England the groups of standards which were prevalent in the various colonies.

I understand that recently the State of Virginia has found a standard yard of the year 1744. The history is a very long one and a very interesting one, but I only want to give this point in regard to it, and that is it has been very difficult to maintain a standard yard—extremely difficult. The standard yard of England was destroyed in 1834 by the burning of the houses of Parliament. That in itself brings up and suggests a

certain conservatism in England, which we ought not, in the opinion of many of us, to follow.

For example they were many decades in following the Continent to adopt decimal numbers; they were many decades behind the country. A fire in the houses of Parliament was the cause of the burning of the old wooden tallies which were still used in connection with the accounts of the exchequer. They used the old Roman numerals long after they had been abandoned by other nations. When those old wooden tallies were burned, the houses of Parliament burned with them, and both the pound and the yard were gone. They had to reestablish the yard and pound. That has been a difficult thing to do.

The United States has not been able to keep with them because of the changeability of the material of which those yards were made. Consequently when the metric system was studied by Congress in 1866 they recognized first of all the metric system for all purposes. In 1870 France called a convention of nations with a view to considering the international character of the metric system and establishing international standards under international custody.

The result of those conferences, from 1870 to 1875, was that on May 20, 1975 the United States of America entered into a treaty with sixteen powers. That treaty was ratified by the Senate and it resulted in three things—the establishment of the International Bureau of Weights and Measures, which is now maintained for the custody of the metric standards, and the administration of the technical and scientific side of the metric system. Therefore we have the organic administrative machinery for the administration on a world scale of the essentially international features of the metric system.

That same convention established a committee, an international committee, which should consist of technical representatives of all the nations that were parties to that treaty. It also established a general conference which should meet at least once in six years, for the purpose of considering the questions of progress, the question of the maintenance of the standards. And I will say that the international meter bar and the international kilogram have been given a most enormous amount of scientific research, covering at least about 11 years of thoroughly careful work by at least 11 scientific, technical commissions, in order to use the standards which we have to-day, and which have been distributed to about 40 countries.

Those standards were so perfect that the United States of America, with the yard changing as it had, and with the British unable to keep even copies of their own standard in substantial agreement—there was nothing left for the United States to do but to adopt the best equivalent known, and a determination was therefore made, which resulted in the equivalent we now have, of 1 meter equaling 39.37 inches. I am not going into the details of that because it is all a technical point.

The CHAIRMAN. Oh, no. I want to keep the record down to the consideration of this bill. This is all interesting, of course, but it really has no purpose in this hearing. If you care to you might supply a statement, for the record, of the historical phases of it. You may do that, if you desire, Mr. Hubbard. But it is discouraging that we can not keep near the purposes and aims of this bill, as to its feasibility and practicability. I am more interested in that than I am in the history of the system. A technical discussion of the subject, or an historical discussion, does not help us to an understanding of the problem that is before the committee.

Mr. HUBBARD. Shall I add a very brief statement?

The CHAIRMAN. You may do it, yes.

Mr. HUBBARD. The first point I would make with respct to the bill is that our present system is inadequate, that it does not begin to meet, and can not hope to meet, the needs of scientific work. That was recognized years ago, that the present system has been found, as exhibited by the typical case of the bushel, to be of appalling complexity, and with respect to the ton, introducing the most diverse and confusing misunderstandings.

One recent misunderstanding, reported to me over the phone, was that where an Illinois purchaser wished to buy from England a certain tonnage of insect powder. At the last minute the man inquired about the ton, and they disagreed on the ton at once, although negotiations had been pending for some time. In some cases that might have been delivered on the tonnage given in England, and the man in Illinois, or wherever the case might be, would have to receive whatever tonnage, or volume, the sending office were to deliver.

The CHAIRMAN. On that subject, which is an interesting one and has some relationship to this matter, do you think it impedes the present system of commerce between the States on account of having a long ton of 2,240 pounds and a short ton of 2,000 pounds? How often do things of that kind occur?

Mr. HUBBARD. I think they are occurring continually, and people are misled without knowing it often.

The CHAIRMAN. I never had an instance and I have farmed all my life, where I got confused with a ton, or in the selling of property by the acre, using that as the unit, or the measurement of land by the rod, or the use of the foot.

Mr. HUBBARD. May I illustrate the land?

The CHAIRMAN. That is the proposition. There are certain classes that want the change immediately. In a commercial way what is the suffering to-day by reason of our present system? That is the point.

Mr. HUBBARD. It is the appalling complexity of the units, which must be unraveled if we are going to do business.

I have here actual, practical tapes that are used in construction and the handling of land. If you recall, the United States Geological Survey makes the fundamental surveys. Those fundamental surveys are made in the metric system, by the meter. If the land is bought the surveyor is called in, and he surveys by the length, and this [indicating] is the unit he uses, and the unit of length is 7.92 inches. When the surveyor has finished they must turn to another instrument.

The CHAIRMAN. That is the link?

Mr. HUBBARD. Yes. If they call in the engineer, who must become a subcontractor to do the excavations, he measures by the foot and tenths of a foot, and he must use a still different tape. If, finally, the architect is called in, he uses the feet and inches and goes down to the eighth of an inch.

Here we have four different methods of subdivision, four different tapes required in the handling of the construction for a single public building. All I say is, if the system——

The CHAIRMAN. That has not impeded the growth of this country beyond the imagination of the ancients, has it?

Mr. HUBBARD. We can not tell. We might have been able to do very much more if we had——

The CHAIRMAN. Do you think it would have increased the volume of business, added to the wealth of the country?

Mr. HUBBARD. Yes, sir.

The CHAIRMAN. I have found from a practical standpoint, from the standpoint of the practical business man, that it is business and markets you want rather than a method of doing the business.

Mr. HUBBARD. If you would like to discuss that phase, I would be glad to have Mr. Bearce take that up.

The CHAIRMAN. I am not discussing it.

Mr. HUBBARD. Will the chairman permit me to retire for a few minutes?

The CHAIRMAN. Certainly.

Mr. RICHARDS. While you are on that, to show the practical difficulty in changing from the surveyor's measurements, in New York City, for instance, we have the streets measured in feet and fractions of a foot. Where you come to the curb there is the practical problem. I have seen thousands of dollars lost in measuring fractions of an inch—an 8½-inch curb. You go on still further, into the architect's work, and you find finer divisions, minor fractions of an inch and decimal fractions of an inch. Those are constant calculations which are hard and very expensive.

The CHAIRMAN. I would think if that is true, that business men would agree upon some form of weights and measures that would be most acceptable to that character of business. We do not usually need by legislation to enforce upon people something that is really instrumental in benefiting their business.

Mr. RICHARDS. We do. We are trying to show you that there is one particular little group, led by the gauge manufacturers, that are opposed to this legislation and the work they have done in making that opposition noisy; and these things that Mr. Hubbard has shown you lead up to the fact that legislation in every country in the world for the metric system has come in along the lines of this practical bill; it has come in by the legislators of the country deciding that this thing is in the interest of the country, and going to work and fixing a date.

The CHAIRMAN. That is interesting. I wanted to know what the other nations have done. Has this been adopted by enforcement statutes?

Mr. RICHARDS. Yes, sir; by inforcement statutes. In every country in the world, that is shown by history.

The CHAIRMAN. You are familiar with that proposition?

Mr. RICHARDS. I am not only familiar with it, but I have been twice around the world.

The CHAIRMAN. What has been the measure of time given to the people to adopt the system?

Mr. RICHARDS. It varies in different countries. We can get that information *for you,* of how it has been adopted in the various countries and its progress to date.

In Japan, I might say, the period has been left to what we would call our department of commerce. Their representatives, Tomagata, I believe, came through this country, and telephoned to me in New York City, about three weeks ago on his way to the International Bureau of Weights and Measures. I had an hour's interview with him and he told me, with great frankness, that the Japanese had decided to do away with the shaku, and all other weights and measures, and that on all government work Japan wants to use only the metric system. That is in dealing with the public. So that no man could come in after five years time and sell so many shaku of wood, for instance. And in addition to that the people in the country, the farmers, the people we have been speaking of, are going to be gradually educated. They will hear of such hearings as this, they will hear of the progress in the metric movement, and the government of Japan has decided that within 10 years, independently from this bill and after seeing this bill, all the people in Japan shall deal in their transactions in the metric system and the work in the machine shops shall be done in the metric system.

So I think you will find, sir, that legislation throughout the world has been along the lines of this bill.

You speak of manufacturers. The General Electric Co. came in and joined as a $5 a year member. They later became dissatisfied and joined as a $100 a year member, and they are paying us $100 a year to continue the educational work we are doing. In visits to their Schenectady plant I have yet to find an engineer who is not heartily in favor of the metric system, not merely because it is in the interest of the country, but because it is in the interest of his business.

We have put our association on a business basis, not depending on the educators, and people who have the good of the country at heart, but on those who are hard-headed business men who see the advantage of this thing in their shops. They are the people who are supporting our association.

Here is a set of records giving the opinions of such men as William C. Wells, who makes a statement similar to this: "Scarcely a vestige of the old standards is left in any country that has adopted the metric system. Now and then in Latin-American countries one will hear of the old words, but almost always with a meaning adapted to the new scale." That is, they will speak of the old weight or measure, but that old weight or measure will be a weight or measure of 20 meters or 10 liters.

Incidentally, in that connection, the use of bushels is entirely practicable, namely, to call the bushel 35 litres when you speak of measuring capacity. So if the American system is based on the system which it ultimately will have to be based on, you will find that our business will increase, the farmer will gradually get used to it, especially when this bill goes through. He will gradually get used to speaking of a certain number of feet as 5 meters or 8 kilometers, and gradually the thing will go through; and that, backed up by the fact we know it is in the interest of the country, will be merely the discharge of a duty.

The CHAIRMAN. How far did that other bill get that was introduced in 1904?

Mr. RICHARDS. In 1904, I do not recall how far it did get. I can look it up.

The CHAIRMAN. It is not important.

Mr. CROCKER. One of the bills—I do not know whether or not it was that bill—passed the House at one time I recall.

The CHAIRMAN. Was that compulsory, the same as this, in the period of time?

Mr. RICHARDS. Yes. It passed the House and was killed in the Senate by one man. It was going through, but one man got up and said, "I wonder what the farmers in such and such a State would say." And then he misquoted the use of the metric system and spoke about a metric system unit that was never used, and the name being unfamiliar to the people, naturally unfamiliar, because they are used to meters and liters and grams——

The CHAIRMAN. I do not know whether they are or not.

Mr. RICHARDS. But he spoke of this one thing and he just got enough people with him, together with the organized opposition, to kill it in the Senate.

The CHAIRMAN. When was that?

Mr. RICHARDS. That was in 1906, I understand.

The CHAIRMAN. That is interesting history, where one man killed a bill.

Mr. RICHARDS. One man, together with Messrs. Dale and Halsey.

The CHAIRMAN. Well, I think much of the principle, of course. But it is a great responsibility that one assumes in forcing by compulsory law new ideas and new formulas upon the public. You have to go at it slowly and in a practical way.

Mr. RICHARDS. It has been going since 1866.

The CHAIRMAN. It may go that much longer; you can not tell, you know. I want to get in this hearing as much as I can the human side of it. There are lots of things that are good, as I said a while ago. We would all glory in a common religion, in a common tongue. But those things can not be obtained overnight. This is a system which has much to commend it, as all things do which are standards, the world over. The question is whether it should come through the different channels I mentioned a while ago or in some new way. That is the thing that concerns me now.

Mr. RICHARDS. In answer to your question I would emphasize the history of the metric movement in all other countries, which history shows that a definite time was set by consent of the majority.

The CHAIRMAN. Does anyone know whether Mr. Hubbard is ready to resume now, or will be later. If he wishes to go on this afternoon, we can adjourn now for lunch.

Mr. CROCKER. I am unable to locate him. He seemed indisposed as he went out, and I am informed that at the bureau this morning he was complaining of feeling ill.

The CHAIRMAN. Very well. We will adjourn now, to meet again on Monday, October 24, at 11 a. m., at which time Mr. Hubbard can complete his statement, and we will hear Dr. Wiley and such other witnesses as appear.

(Accordingly, at 1.15 o'clock p. m., the subcommittee adjourned until Monday, October 24, 1921, at 11 o'clock a. m.)

THE METRIC SYSTEM.

MONDAY, OCTOBER 24, 1921.

UNITED STATES SENATE,
SUBCOMMITTEE OF THE COMMITTEE ON MANUFACTURES,
Washington, D. C.

The subcommittee met, pursuant to the adjournment of October 13, at 11 o'clock a. m., in the committee room, Capitol, Senator Charles L. McNary, presiding.

STATEMENT OF MR. EUGENE C. BINGHAM, PROFESSOR OF CHEMISTRY, LAFAYETTE COLLEGE, EASTON, PA.

The CHAIRMAN. Mr. Bingham, we are considering Senate bill 2267, fixing the metric system as the single standard of weights and measures in the United States. From the memorandum I have in my hand you are here to testify to-day.

Mr. BINGHAM. I am.

The CHAIRMAN. Where do you live?

Mr. BINGHAM. At Easton, Pa.

The CHAIRMAN. You may give your name in full to the reporter, and your occupation.

Mr. BINGHAM. Eugene C. Bingham, Easton Pa.; professor of chemistry at Lafayette College.

The CHAIRMAN. Mr. Bingham you may go ahead in your own way to discuss this bill which we are now considering.

Mr. BINGHAM. I have been over this bill and I advocate it very strongly. I was drawn particularly to the metric system as a student and then when I was going over as a student to England a Canadian told me that the English could use their coinage—pounds, shillings, and pence—as readily as we could use dollars and cents; and I was interested to see whether or not that was the case.

When I got over there I had occasion to buy several dozen pairs of gloves in a store in Cambridge. The clerk there tried to figure it up and was unable to get the exact amount. He called the floor manager and he figured it up but had difficulty in getting the amount, and they called in a third party. After they got the amount I saw that it was not the right order of magnitude even. So between them they got the sum which they thought was right and I paid the bill.

It struck me then that was the same situation we were facing over here. Later on I was a guest at the Bureau of Standards, and I found that the Government was unable to start this movement because they were depending on the people to start it, and I resolved then that I would, if I ever got a chance, take some step to show those who represent the people that this was a very desirable work—of introducing the metric system in America.

I am a member of the American Chemical Society, with 15,000 members, and am now chairman of the metric system committee. The American Chemical Society has for a long time taken a very vigorous attitude toward the adoption of the metric system. But recently I have felt we ought to do more than that; we ought to take steps to bring about that adoption even though the Government did not do it by legislation; that we ought to make progress in any case.

So as chairman of this committee I have been corresponding with chemists, principally in the first place with colleges and universities of the country, and I find that already 190 of the colleges and universities of the country have

agreed to ask for specifications and purchase as far as practicable all of their chemicals and chemical apparatus on the basis of the metric system. I have not had any question raised except by one institution, a very small institution, the College of Pharmacy at Cincinnati, which is the only one that has raised a question. They are all very strongly in favor of its adoption.

I have corresponded with a large number of dealers and manufacturers. I would like to point out that the Eastman Kodak Co., without any suggestion on our part, is already manufacturing synthetic chemicals and dispensing them entirely on the metric basis. So that if they get an order in English units they transfer it over to metrics and send them out as such.

The National Drain & Reagent Co., and certain other companies whose names slip my mind for the moment, sell all their apparatus on the basis of the metric system.

The Synthetic Chemicals Co., of Chicago, wrote me that they were just about—as soon as they could get bottles, indexes, containers, etc.—to go over to metrics.

Mr. Will, of the Will Corporation, told me, about September 1, that he was going to publish a catalogue giving the items that they manufacture in metric units.

The J. T. Baker Chemical Co. are large chemical manufacturers, of Phillipsburg, N. J., and they are entirely willing, to my positive knowledge, to specify and supply chemicals in metric units. In their recent catalogue, of August, 1921, they have a full page devoted to metrics, showing the customer that he can get his metric prices from the catalogue in pounds and ounces with perfect ease. All that is necessary to do is to add one-tenth to the price in pounds, and that is the price in metrics.

Mr. Adamson, of the Baker & Adamson Chemical Co., a branch of the General Chemical Co., wrote me that at that moment he was having a new catalogue printed which would schedule metric prices.

Very recently, Powers, Weightman & Rosengarten Co., very old manufacturers of chemicals for the drug trade in Philadelphia, have brought out a line of analyzed chemicals for the first time. The bottle bears on it the metric unit and not any English unit whatever. Their catalogue absolutely ignores any knowledge of any English system.

So, presumably companies of that type will, if they receive orders in English units, ordinarily supply them in metric units. That is, they will transfer them over.

We are trying, in our committee of the American Chemical Society, to accomplish the sale of pure chemicals in America exclusively in metric packages. There might be an objection raised to that on the part of a person who was not familiar with the situation. He might say that that will add to the number of packages that are necessary. As a matter of fact, before we began our campaign, the committee on guaranteed reagents and standard chemicals saw the confusion that there was in our present system, the number of packages being far in excess of the number that is necessary, and they agreed to adopt as the standard package, 500 grams.

If we accept that which has been adopted by that committee as a standard, 500 grams, then we will take 100 grams as a subsidiary unit, and we will probably not have many other units. That is, we do not want to have 250 grams or 50 grams. There are a few things, like radium, that have to be put up in smaller packages than 10 grams or 100 grams, where you have to get down to fractions of a gram; but the unit package is going to be the 500 grams, which is only one-tenth more than 1 pound.

Another objection that might be raised is that our present bottles and containers are all made with the idea of using pounds and ounces. But, as a matter of fact, the chemicals which are sold do not all have the same specific gravities. In talking the matter over with Baker & Adamson and J. T. Baker, we found that without knowing at the time the recommendation that had been made by the committee on standard guaranteed reagents, we came to exactly their conclusion, that the bottles which are now used for holding standard acids and ammonia can be used without any trouble in holding those acids when they are packed in the metric unit.

For example, we are going to put in 2 kilos of ammonia, 2½ kilos of hydrochloric, and 4 kilos of sulphuric acid in those same bottles which were formerly used for acids. In other words, those bottles were not filled to the top because the materials were not of the same specific gravities and they could not do that. They have to leave a certain space on account of their shippage. *Nitric acid* expands when it is carried over a mountain range, for example,

particularly in warm weather, and if the nitric acid gets out it will cause trouble from fires. There is always considerable space left in the bottle, and that is true whether you use metric or English; there is quite a little room there for change. As a matter of fact, in the case of ammonia we get a little more in the bottle than we did before, which will lower the freight rates.

The CHAIRMAN. These institutions about which you speak are voluntarily adopting this system?

Mr. BINGHAM. They are voluntarily adopting the system in purchases.

The CHAIRMAN. Do you think, inasmuch as they are taking that attitude toward this system, that legislation is prudent or necessary?

Mr. BINGHAM. I think it is very important. I think the fact that those colleges are voluntarily adopting it, enthusiastically adopting it, shows how strongly they think it should be adopted generally.

The CHAIRMAN. Speaking of the business concerns you mentioned, they are getting along by voluntary adoption of the system, are they not?

Mr. BINGHAM. Yes.

The CHAIRMAN. What good, then, would legislation do them?

Mr. BINGHAM. Simply that we as chemists believe that what is good for the chemical industry is good for the people at large. Take rubber tubing, for example. Rubber tubing is usually sold and manufactured in feet. It would be easier—I won't say it would be necessary, but it would be easier if throughout the country rubber tubing were sold by meters and by diameter measure, by centimeter. I find, as a matter of fact, in laboratories throughout the country up to this time they have been selling rubber tubing in feet and inches, although most of the laboratories and many of the apparatus dealers have been specifying and stating the diameter in millimeters. It is the hodgepodge of the present system that is annoying to the scientist.

The CHAIRMAN. Yes; I have heard a good deal about the scientist and the chemist and the engineer.

Mr. BINGHAM. I am testifying primarily as an engineer and a chemist.

The CHAIRMAN. What about the great mass of the people? Do you think it would help them?

Mr. BINGHAM. Yes, sir. I believe that the great mass of the people do not realize how much it would benefit them.

The CHAIRMAN. What practical benefit would it have for a farmer over in Maryland that is raising wheat?

Mr. BINGHAM. I was brought up on a farm, and I am a farmer myself; I have a farm up in Vermont. I buy fertilizer, for example, for my farm, and I buy coal for my cellar; my wife buys produce in the market. I lived in Virginia for a while and I bought coal down there, and I got 2,000 pounds for a ton. I moved to Pennsylvania not long ago and I got 2,240 pounds for my ton of coal. I did not know that, and the dealer could have taken advantage of me if he had been unscrupulous.

The CHAIRMAN. But he was not, and so you were not injured.

Mr. BINGHAM. I was not injured in that particular case. But it is certainly true, to my positive knowledge, that the farmer is being injured by unscrupulous dealers in different parts of the country. Not only that, but our scrupulous dealers find themselves very greatly handicapped in their dealings with different people when they are in doubt about the units they are using.

For example, in a certain case that I know of, there was a shipment to Australia of castor oil, if I recall. It amounted to many thousand dollars' worth of material. There was a misunderstanding as to whether they were using the United States standard gallon or the imperial gallon. The Australians claimed that the smaller gallon was substituted on them, and it amounted to $10,000. The American firm was perfectly honest in doing that, but in order not to lose their Australian trade they made up the difference.

I believe, in connection with the farmer, to get back to the farmer, the farmer will gain in several different ways if the adoption of the metric system is brought about. The farmer goes to school, in the first place, as a boy, and he struggles over his arithmetic. It has been calculated that in this country there will be a saving of a million years in one generation if we adopt the metric system. That is to say, there is not a man in this room that knows all the units of the English system. For example, a barrel of flour is made up of a certain number of stone—I forget just how many. It was originally based on that obsolete unit. As a boy we used to measure a horse in hands, and just for the moment I have forgotten how much a hand is when translated into inches. We measure wood by the cord. We used to do it very roughly.

In a primitive civilization I believe that the English system will serve. You can measure off certain things by your hand, by your foot, by the span of your arms, in yards. But we believe as our civilization develops, as our world becomes smaller, it is inevitable that we must make this change. Those who are conservative in making changes are going to fear that our civilization has already gone so far that the change can not be made. On the other hand it must be made. We can not live together on this earth without eventually a single system of weights and measures.

The CHAIRMAN. Do you think that is more important than a common tongue?

Mr. BINGHAM. I believe that a universal system of weights and measures is practicable, and I am not sure that a common tongue is. I do not know that that is answering your question.

The CHAIRMAN. That is getting close to it. Now, to get back to the farmer——

Mr. BINGHAM. In the first place, then, I believe that it would save enormously in education.

The CHAIRMAN. It is a life-saver?

Mr. BINGHAM. Yes; it would save time. In the second place, it will save confusion.

The CHAIRMAN. I am not going to quarrel with you, but I would like to have an answer to this proposition. I can conceive that for the classes of people you mention, engaged in the various occupations referred to, it is a very good thing. What I want to know is, what economic value the adoption of this system will have over the present system for any farmer, ranchman, fruit grower, or live-stock raiser in America. Tell me one advantage.

Mr. BINGHAM. That he can make all of his measurements so much more quickly, so much more easily. A farmer has to calculate the capacity of his bins——

The CHAIRMAN. Let us take an illustration. A man near Rockville, Md., has 80 acres sowed to wheat. A machine comes on to his place; it thrashes the grain, dumping the straw on one pile through a blower, with his grain measured automatically by the machine in 2-bushel sewed sacks, and he delivers that to the market. Is there any system that can beat it? Would he gain anything by having different units of weights and measures? Tell me where the advantage would be by the adoption of this system.

What applies to wheat applies to potatoes, applies to prunes, applies to hay, to everything raised on the farm, including dairy and poultry products. What I am suggesting is a practical question. I have heard so much from you gentlemen who are scientists saying it is a great thing and you are using it, anyhow. This bill is an attempt to enforce upon the great masses of the people a different system.

Mr. BINGHAM. Yes.

The CHAIRMAN. We should not do that unless it is of some advantage to them. I believe it will eventually come through education. I am wondering now whether we should arbitrarily compel people who have reached maturity, where their minds do not expand rapidly and take in things of this kind to adopt the system. But if it is of tremendous practical and economic value to them, that is a different question.

I have given you an illustration as to the wheat grower; what is your answer?

Mr. BINGHAM. I am very glad you did that and made the statement you have, because I have not followed the hearings and have not known the line they have taken.

The CHAIRMAN. They have all said the same thing.

Mr. BINGHAM. It seems to me that the answer to it is very clear.

The CHAIRMAN. Put it into the record. I want to know. Let us get to it.

Mr. BINGHAM. In that particular instance you speak of, it has been so simplified that apparently it is carried out with perfect ease.

The CHAIRMAN. What is?

Mr. BINGHAM. The thrashing of the grain, sewing it up in a certain sack, and disposing of it.

The CHAIRMAN. So you will concede in that instance which I have illustrated there would be no advantage to the wheat grower in Maryland by adopting the metric system of weights and measures?

Mr. BINGHAM. No direct advantage in that particular operation. I can not see how it could.

The CHAIRMAN. Let us go out to the plains of northern Montana and take the man who raises beef cattle and who sells them by the pound. Of what advantage would it be to that fellow?

Mr. BINGHAM. The advantage that I see——

The CHAIRMAN. Would his income be greater? Would the handling of his stock be easier? Would any of his business transactions be computed more readily and with any less effort than under the present system?

Mr. BINGHAM. Yes, sir; it seems to me so.

The CHAIRMAN. How?

Mr. BINGHAM. If I may be very concrete, let me give an example from my own experience of last summer. I was on my own farm and I was proposing to sell a piece of land. That land was reputed to be so many acres, more or less. I paced that land off with another man, and we then attempted to calculate that into acreage. I have done some surveying in a professional way, but when you have measured that off in feet and inches and tried to compute that in terms of acres it is rather a complicated process.

The CHAIRMAN. I spoke of live stock, and you have gone off onto acres.

Mr. BINGHAM. I just carried that over there for the purpose of being concrete. I thought it was the same thing.

The CHAIRMAN. I do not think it is the same thing at all. A man takes a bullock to the market, puts it on a scale, and it weighs 1,100 pounds and is worth 4 cents a pound on the hoof.

Mr. BINGHAM. Yes.

The CHAIRMAN. How can you beat it?

Mr. BINGHAM. In that particular instance it does not make any difference, because 1,100 pounds does not involve any fractions; it does not involve two different units of our system. But if you take a case which involves tons——

The CHAIRMAN. Long and short tons?

Mr. BINGHAM. Yes; the long and short ton, or a case where the unit is mixed, where it is a question whether it is the avoirdupois pound or the Troy pound——

The CHAIRMAN. You are getting back into science. I am speaking of the great masses that live out in the country and in the small towns. Of what particular advantage is it to the wage earner who works in a factory and gets $4 a day? Where does the metric system help him in any conceivable way, in the matter of enjoyment, in his livelihood or in his betterment?

Mr. BINGHAM. In the first place, I should say in education; then in the ease of making his calculations; then in the lessened chances of his being defrauded.

The CHAIRMAN. I have heard of only one possibility of his being defrauded, that of the long and short ton, applying mostly to the coal industry. But a man would be stupid and dull who did not take that into calculation.

Let us jump across the Cascade Mountains and go to the fruit industry on the Pacific slope. A man raises 100,000 tons of dried prunes, selling them at 12 cents a pound. Would he be bettered in any way by a change in the system?

Mr. BINGHAM. I would say that was the same question as the other one.

The CHAIRMAN. It is a different problem.

Mr. BINGHAM. If it was metric, it would come out an even number in the same way. The cents would come out the same number; it would be just the same sort of application.

The CHAIRMAN. Doctor, do you think the matter is of such impelling importance that we should by legislation compel people arbitrarily to take it up, or let the thing come about gradually through an educational process?

Mr. BINGHAM. I think the provisions of this bill bring about a gradual process. I should say there was a sufficiently long time there to bring about that education of which you speak.

The CHAIRMAN. In your opinion, how long would it take the average citizen of the country, who has been out of school 25 or 30 years and has had but little time for reading and general study, to become acquainted and familiar with this metric system?

Mr. BINGHAM. I should think that any person who could read and write could be taught the metric system in half an hour.

The CHAIRMAN. I think you hold the record for shortness of duration.

Mr. BINGHAM. I teach classes in the metric system.

The CHAIRMAN. I have a most interesting little pamphlet here, containing various tables of length, tables of area, tables of volume, tables of capacity, and table of weight, metric equivalents or double markings for labels. Do you think the average man could learn those tables in 30 minutes?

Mr. BINGHAM. I do not think it is necessary, sir, to know those tables after the metric system is in use.

The CHAIRMAN. Would it not be necessary, then, to refer to some pamphlet or book containing the tables?

Mr. BINGHAM. Not in using the metric system; no, sir.

The CHAIRMAN. It would not?

Mr. BINGHAM. I do not think so. The tables are necessary now while we have this mixed system.

The CHAIRMAN. You advocate the passage of this bill?

Mr. BINGHAM. Yes, sir.

The CHAIRMAN. You think it ought to become obligatory through legislation?

Mr. BINGHAM. Yes, sir.

The CHAIRMAN. That is based on the general welfare of the public at large rather than the convenience of engineers and chemists?

Mr. BINGHAM. Oh, yes; yes, sir; I think we are willing as scientists to undergo great inconvenience, if it were necessary, for the welfare of the public at large. It is for the public at large that I am down here to-day.

The CHAIRMAN. From what you said I take it you have read this bill?

Mr. BINGHAM. Yes; very carefully.

The CHAIRMAN. Has it the indorsement of your society?

Mr. BINGHAM. Yes, sir.

The CHAIRMAN. Without amendment or change in any particular?

Mr. BINGHAM. I would not say that.

The CHAIRMAN. Have you any suggestions to make regarding an amendment?

Mr. BINGHAM. No: I have not.

The CHAIRMAN. Or the omission of any provision?

Mr. BINGHAM. No.

The CHAIRMAN. Professor, is there anything else you desire to say in connection with this proposed legislation?

Mr. BINGHAM. I have some documents here which I would like very much to enter in the record. They are the statements of a large number of gentlemen, such as Thomas Edison, Luther Burbank, and Alexander Graham Bell.

The CHAIRMAN. You would like to have these inserted in the record?

Mr. BINGHAM. I would like to.

The CHAIRMAN. Very well; they will be inserted.

(The papers referred to are here printed in full as follows:)

MEMORANDUM FOR METRIC SYSTEM COMMITTEE, CHAMBER OF COMMERCE OF THE UNITED STATES.

Among the leaders of American thought who have declared that they are in favor of metric standardization of weights and measures are:

Thomas A. Edison: "I have for years been in favor of the adoption of the metric system and would like to see it substituted for our present jumble."

Alexander Graham Bell: "Congress did well in abolishing the old system of pounds, shillings, and pence and adopting the decimal system for our money, and we will do well for the future of our country if we provide the metric system for the whole of the United States."

John Hays Hammond: "I am convinced from an intensive study of international commerce that the adoption of the metric system would greatly facilitate promotion of the export trade of America."

Hudson Maxim: "I believe that there should be a universal standard of measure, and that the United States Government should adopt the metric system."

Luther Burbank: "The metric system if adopted by the whole world will, without doubt, simplify the science of weights and measures beyond computation."

Henry Ford: "We heartily approve of any step toward the adoption of the metric system in the United States of America."

Samuel Vauclain, president Baldwin Locomotive Works: "We could change to the metric system or we could use both systems without incurring any appreciable expense at the time. My opinion, however, is that were we all using the metric system it would be much more convenient to the workmen and our errors would be appreciably less than they are at present."

R. T. Crane, jr., president Crane Co. (59 branches, manufacturers of about 20,000 articles): "I am a very strong believer in adopting the metric system in this country, not only on account of its simplicity compared with the old stand-

ards but also as a means of helping all manufacturers in distributing their products throughout the world."

Elihu Root: "I am in favor of keeping up the process by which the world may ultimately come to a general employment of the metric system."

Gen. Leonard Wood: "I am familiar with and believe in the metric system."

Gen. John J. Pershing: "I believe that it would be very desirable to extend the use of the metric system in the United States to the greatest possible extent."

Samuel Gompers: "I firmly believe and long have believed that the metric system offers a return to simplicity, offers an effectiveness of thought, offers much, even, to children in our schools which we are not justified in withholding from them."

Otto H. Kahn: "I favor a unified world standard of weights and measures on the basis of the metric units of meter-liter-gram."

James Speyer: "I am in sympathy with the effort to have our country adopt metric units."

Charles W. Eliot: "The adoption of the metric system by the United States of America would greatly reduce labor in trades, because of the thorough decimal quality of the system, and would facilitate teaching of mathematics and applied sciences in schools."

Nicholas Murray Butler: "The adoption of the metric system by English-speaking peoples would advance world trade as it already has advanced science."

William G. McAdoo: "A very great stimulus indeed would be effected by our accepting the metric standards of industry, education, and science now in use throughout the world."

Franklin K. Lane: "I am in full sympathy with this effort."

John Barton Payne: "The value of the metric system of weights and measures has been demonstrated and should be adopted by the United States."

William C. Redfield: "We may just as well get ready to adjust ourselves to the great world by making this advance to the metric standards."

J. W. Alexander: "I am in sympathy with and favor the adoption of the metric system as a universal system."

W. B. Wilson: "I am in favor of the adoption of this system."

Among the large American newspapers which urge metric standardization of weights and measures are:

New York Herald: "All trades and industries would be benefited by the adoption of this standard, which is uniform, accurate, and easily understood, adapted to every practical use, and known and accepted throughout the civilized world."

New York Sun: "The world is in a frame of mind for such unifications and standardizations. Moreover, the great international trade of the future is entitled to the simplest, most economical processes."

New York Mail: "With a backwardness which is wholly at variance with American traditions, we still cling to the old inconvenient, unreasonable, and utterly inexcusable measures of weight, distance, and volume. Let us throw these out and adopt the most reasonable system of measurement in the world—a reckoning based upon the numerical system itself."

Chicago Tribune: "Our present system of weights and measures has no support except tradition.

"Our currency is founded on the metric principle, and its convenience is obvious to everyone. We probably do not realize how much time and trouble is involved in using our present standards of length and mass."

Los Angeles Examiner: "Still there are many grave matters of preparation that are being neglected. One of the most important of these is the necessity at once to free our commerce from the handcuffs of medieval terminology by adopting the metric system of weights and measures."

Detroit News: "Favorable action by this country would place our people in commercial harmony with a world of opportunity. We ought to get upon the wagon of progress."

Christian Science Monitor: "The question of weights and measures is pre-eminently a subject which can not and ought not to be treated lightly. It is fairly safe to say that no one, unless he has some specific reason for securing the information, has any idea of the enormousness of the Anglo-Saxon system of measurements in every sense of the word."

There has been much recent progress toward the achievement of world metric standardization of weights and measures:

Japan adopts metric units.—News comes by cable that the Japanese Parliament has definitely achieved metric standardization, to be put into effect after April, 1922. This news is of world importance. It is conceded that the future trade of the Pacific will be on the decimal metric basis, and the advantage to Japan from this common language of the Pacific will be monumental and immediate. Japan is already using effectively metric weights and measures in her army, in her railroads, and for engineering work.

China is advancing to metric standardization.—In 1918 metric weights and measures were established as the standard for China. It was expressly stated that the metric units were made legal and official as the first step to exclusive adoption. China made this great advance to realize the advantages of world metric uniformity, although she has had a decimal system of weights and measures from ancient times.

Russia, Poland, and Latvia adopt metric units.—A special correspondent of the New York World sent this note from Petrograd, Russia, October 12, 1920: "An executive order directs that the metric system be officially used on and after January 1, 1922."

"The meter has been introduced as a unit of measure in all Poland and the use of other measures is now prohibited." (Algemeen Handelsblad, Amsterdam, Netherlands, Oct. 28, 1919.)

"The Letvian Government has passed a law introducing the metric system, but the old Russian system of weights and measures may be used where necessary until January 1, 1926." (Commerce Reports, United States Department of Commerce, Feb. 19, 1920.)

Greece adopts metric units.—"The Government Gazette publishes a new law passed by the Chamber of Deputies which makes the metric system the official system of measurement throughout Greece." (Foreign correspondence of New York Evening Post, Nov. 18, 1920.)

Dominican Republic and Haiti.—Latest reports say that metric weights and measures have been adopted by the Dominican Republic and that Haiti proposes a similar step.

American and British progress.—Virtually all the world except the United States of America and the British Isles has adopted the metric weights and measures.

A large part of the British Empire now urges metric standardization. The Australian and New Zealand legislatures have placed measures on the statute books authorizing the exclusive use of metric weights and measures, subject only to simultaneous adoption in the British Isles. Metric units are extensively used and their general adoption is strongly urged throughout the British dominions.

Use of the metric units is now widespread in the United States of America.

In Porto Rico, Cuba, and the Philippines metric weights and measures are used exclusively in all official and domestic transactions.

Metric units are used exclusively in such Government work as that done by the Coast and Geodetic Survey, the Medical Departments of the Army and Navy and branches of the Post Office Department dealing with metric countries.

Metric weights and measures are used virtually exclusively in science and in the electrical, chemical, and optical industries.

Hundreds of manufacturing concerns to-day employ the metric units. Wholesalers, such as those in the grocery, canning, and drug business are urging and adopting metric marking for package goods. Nearly all small tool manufacturers are putting out a rather full line of metric products along with the regular line. The general adoption of metric units is urged and these standards are used extensively by such great industrial firms as the Goodyear Tire & Rubber Co., the Waltham Watch Co., and the De Laval Separator Co.

In January, 1920, the Second Pan-American Financial Congress held in Washington, D. C., passed resolutions urging the adoption at the earliest possible moment of the metric system by the United States of America.

In March, 1920, the city council of Chicago, Ill., by unanimous vote (66 to 0) adopted a resolution urging that the United States of America and the British Commonwealths make the metric weights and measures the exclusive legal standards.

Now, in 1921, the metric standards bill (H. R. 10) has been introduced in Congress by Hon. Fred A. Britten, of Illinois. The bill provides for a gradual transition to the decimal metric weights and measures during a transition

period of 10 years. It applies to merchandising, not manufacturing. Manufacturers may employ any units in production; but commercial transactions are to be on the decimal basis, already used to such advantage in the coinage of the United States of America.

Mr. BINGHAM. Here is something from Col. Forbes, of the war-risk insurance.

The CHAIRMAN. That may go in.

(The paper referred to reads as follows:)

TREASURY DEPARTMENT,
BUREAU OF WAR RISK INSURANCE,
Washington, July 15, 1921.

Mr. W. MORTIMER CROCKER,
Washington, D. C.

DEAR SIR: I have your letter of July 2 requesting my views on the movement to have adopted the metric system of weights and measures by the United States, and owing to the pressure of business it has not had my earliest attention.

I am glad of the opportunity to add my indorsement to this movement, and, being an engineer by profession, have found that its systematic decimal relations greatly facilitates rapid and accurate mental as well as written calculations. For this reason, together with the fact that three-fourths of the nations of the world now use it almost exclusively, I venture the prediction that the achievement of your most sanguine expectations will be early realized.

Yours, very truly,

C. R. FORBES, *Director.*

Mr. BINGHAM. Here is something in regard to the ease with which an industry is changed over. That is taken from the Electrician, and will show how we can change over from the English to the metric.

The CHAIRMAN. I think, perhaps, that would be useful to the committee.

(The paper referred to is as follows:)

"The Electrician (London), in its issue February 25, 1921, page 251, in an article, 'Standardized Electric Motor Manufacture,' describes the standardization work of Messrs. Higgs Bros., of Birmingham. The article announces that the firm has adopted the metric system in its work. The following is a quotation from the article under the heading

"'The use of the metric system.

"'Parallel with this technical development the business of the firm increased to such an extent that in 1917 a removal was made to the present works in Sand Pitts. At the same time the interesting step was taken of changing the whole of the operations over to the metric system. This policy will, of course, be criticized from two points of view, its financial disadvantages and the general undesirability and unadaptability of the metric system to British conditions. We may, therefore, point out that on both these scores no disaster has occurred. Nor is this surprising. Jiggs, tools, etc., have in any event to be changed every few years, and opportunity was taken of renewing on the new system rather than on the old. As regards the second point, no trouble has been experienced in any way, except that the steel makers insist that the steel required for making the shafts shall be purchased on the British system. This, however, does not interfere with anything inside the works, as the change over to the metric system is made as soon as the raw material enters the doors.'"

Mr. BINGHAM. I think that is all.

The CHAIRMAN. Thank you very much.

STATEMENT OF MR. DAVID A. MOLITOR, CIVIL AND CONSULTING ENGINEER.

The CHAIRMAN. Mr. Molitor, give your name and address to the reporter, please.

Mr. MOLITOR. David A. Molitor, care of Carl E. Schmidt & Co., Detroit, Mich.

The CHAIRMAN. Proceed in your own way, Mr. Molitor.

Mr. MOLITOR. Would you wish any of my previous experience to show the competency with which I am speaking on this subject?

The CHAIRMAN. Yes.

Mr. MOLITOR. Or is that immaterial?

[illegible]

Section 9: "That nothing herein shall be understood or construed as prohibiting the enactment or enforcement of weights and measures laws or ordinances by the various States or cities," etc. Some cities have legislated, for instance, on the size of berry baskets, on the number of pounds of certain produce that are contained in a bushel, etc.

The second part of that paragraph, "*Provided, however,*" virtually takes that right away from the cities and States to the extent that they must employ the metric system.

Now, the bill, if it did not contain that provision at all, might work just as smoothly. However, it is a safeguard, and therefore I would not say to cut it out, although I do not see that it does a great deal of good.

On the whole my only objection which is really worth considering on your part is the time limit of the transition period—10 years.

The CHAIRMAN. What would you suggest?

Mr. MOLITOR. I am of the firm belief that the longer you make the transition period the less attention will be given to any attempt to avail oneself of the benefits of the metric system. I base that opinion on various experiences which other countries have had in making even more drastic changes than we are contemplating here. For instance, Geremany allowed three years for a transition period in 1872, when it was adopted. Their requirements were far more drastic than anything we have ever considered. They required that everything should be made to the metric system. This bill distinctly exempts that provision; it deals only with commercial transactions. When you eliminate the one feature of specifying that metric dimensions must be used in the manufacture of goods you have eliminated all the practical difficulties; and that you have done in this bill. Germany, however, thought otherwise and accomplished that marvelous feat in less than three years, although they allowed three years to do it.

The CHAIRMAN. What period would you suggest?

Mr. MOLITOR. I think three years is a very ample time limit for the purpose which we contemplate in this act. I might cite an experience which the United States Government had in a similar direction, when the Interstate Commerce Commission ordered freight cars equipped with automatic couplers. This happened some 10 or 11 years ago. There was a time allowance of 5 years given. When that period of time had elapsed absolutely nothing had been done toward making the change. Then the time allowance was extended 2 years and 7 months, during the last year of which most of the cars were equipped, when the railroads made up their minds they had to do it.

That is the crucial point in this whole argument. I have had that experience in introducing the metric system into the Carl Schmidt tannery. You might wish to know why we introduced it. We did it purely to avoid confusion, to make it possible for the quite ignorant employees to do things which they never could have done in our present system of measurements, and to avoid mistakes.

That feat was accomplished without telling anybody anything about the metric system. It was not necessary. Only the purchase of a few metric scales and metric measures was necessary. The rest of the performance was a matter of calculation—office work.

In this leather industry we have a great many complicated processes that are run by men of comparatively no education. Those same men, who found it absolutely impossible to do any figuring in the way of computing quantities in mixed denominate numbers, such as are necessary in tanning and dyeing and finishing leather, can now in the metric system work out all these problems in their heads.

We used to have a book of dye recipes, a notebook of maybe 50 pages, which recipes were necessary in our work, and which sometimes involved two, three, and four dyes and a quantity of each weighed in ounces, grams, scruples, and grains, a mixed denominate number, with cases where each of these quantities was not constant for the same color, but where the quantity of leather dyed in one operation was dependent on the surface contained in a certain weight. Naturally the thicker the leather the smaller the surface; and since dye acts a good deal like paint covering a surface, the quantity must be proportioned on area, and the area in each grading of leather, grading by thickness, would be a different one. Consequently, the amount of dye was different. That made such a complicated mass of figures that the only answer was to do it metrically.

All the dye recipes that we employ now for making some fifteen-odd colors can be written on one octavo size sheet of paper, all expressed in grams and

for area intervals differing by 5 per cent. A standard recipe might be written for 100 square meters and this can be graded up and down by intervals of 5 per cent—an operation which the man who weighs the dyes can perform very easily. Other recipes can easily be written out by stipulating the quantities in percentage, and that recipe will be good for any quantity; whereas had it been given in specific English units for a given quantity, the figuring would be very difficult for some other quantity.

Those, of course, are all operations which are of necessity being conducted by men who have little or no education; yet they are able to acquire an understanding of decimals and of figuring decimally, without very much trouble; whereas similar problems in mixed denominate English units would always involve common fractions, which even to the expert mathematician mean a great deal of labor, if nothing else. Many of us would hesitate in knowing how to perform some of those operations.

As a matter of transition it required nothing further than to supply the necessary scales—and that was not a serious matter—liter-measuring containers, and perhaps a five-minute talk to the men who were going to do the measuring and weighing, and they were able to go ahead and transact their business in a more satisfactory way than they had been able to do before. And many persons whose mental capacity might have unfitted them for such position could readily work the job in the metric system. I am pointing this out because it was a benefit to the laboring man. Many a man got better wages because he could do better work.

I think the same would be true in most any other industry. We have evidences of sudden changes of a similar character made in an organized shop without much preparation, and which turned out work more satisfactorily than they had done using the English units. The Baldwin Locomotive Works had one such experience where they took a contract for locomotives built to the metric system, everything dimensioned and taken from drawings that were metrically dimensioned. This was done, and the comment which the vice president, Mr. Vauclain, made at the time he was vice president of the works, in response to an inquiry of mine, was that there was no greater difficulty in working to the metric system than to the English system. In fact, it was found to be somewhat easier, and the workmen were less likely to make mistakes. He further states that they could change to the metric system or use both systems without incurring any appreciable expense at the time, and adds his opinion that were we all using the metric system it would be much more convenient to the workmen and our errors would be appreciably lessened. This was in 1907, where they built 20 locomotives, slapped them right into their shop, ran them through, turned them out, and sent them to France—all metric. The same company built, I believe, 100 locomotives during the war in the same way without disrupting their shop.

The Dodge automobile factory in Detroit ran a whole department during the war in the metric system, furnishing war material. They had never used it before, and had no difficulty in introducing it. I talked with many of the men who had worked in that department and they said, "If we could only have it through the whole shop."

Now, Mr. Chairman, you have brought up a question which is difficult to answer, and that is, How will the farmer be benefited by such a change? Will he make more money? I would say offhand that possibly as a direct influence he would not make any more money; but indirectly it might involve the question of whether he can sell his produce at all or whether he can sell it all at a good price. By indirectly I mean the effect which foreign trade might have on his exports—not only the farmer but every other institution.

The CHAIRMAN. Do you think the adoption of this system would increase the exports to foreign lands?

Mr. MOLITOR. I think whether we adopt this system or not will determine the question whether we will have very much export trade or not. At the present time we are having some export trade, but you will notice it is falling off rapidly.

The CHAIRMAN. Is that due to the system, to the destruction of wealth during the war, or the unfavorable rate of exchange?

Mr. MOLITOR. I appreciate that question. That is due to many circumstances.

The CHAIRMAN. I have listened to a great many arguments on the floor of the Senate and read many articles, I have been through a prolonged hearing before a joint agriculture commission concerning our export trade, and the

inability of foreigners to take it; but I have never heard the metric system used as one of the impediments to our export trade.

Mr. MOLITOR. Yes, sir.

The CHAIRMAN. I am glad to know you have such view.

Mr. MOLITOR. I have some well-defined views on the matter.

The CHAIRMAN. Before the war, when Europe had not suffered the great destruction of its buying power, there was a very large, an immense, export trade, and we had the present unfortunate system in effect then.

Mr. MOLITOR. Yes; we had an export trade, it is true; and during the war that export trade went up immensely. Since the war we have expected it would remain at that enormous high level, which it has not done.

The CHAIRMAN. Due to the metric system?

Mr. MOLITOR. No, sir; not entirely.

The CHAIRMAN. Specifically?

Mr. MOLITOR. It was a question of supply and demand under emergency conditions. But when the metric system becomes operative as an influence in this connection will be after we get passed the war period, the reorganization stage of the world. When that has been accomplished you will find that people will buy selectively from those countries that sell them the kind of goods they want, and in the manner in which they want them. If we do not care to supply them they know where they can get them.

The CHAIRMAN. Why have they not done that and boycotted us in the past?

Mr. MOLITOR. They have to a large extent.

The CHAIRMAN. They have?

Mr. MOLITOR. Yes, sir. If you will read over the consular reports from foreign countries, you will find that similar statements have been put in there for the benefits of our Congress to take cognizance of for many, many years past, but I do not know that it has ever been given very thorough consideration—as one of the reasons why we should adopt the metric system, especially in commercial transactions.

The CHAIRMAN. Could an exporter at San Francisco or New York buy in American standards and sell abroad in the metric system?

Mr. MOLITOR. Could he buy in American?

The CHAIRMAN. Can't you translate one into the other?

Mr. MOLITOR. Certainly.

The CHAIRMAN. Can not that be done in America with foreign countries.

Mr. MOLITOR. Yes, sir.

The CHAIRMAN. If they want our products?

Mr. MOLITOR. Yes, sir.

The CHAIRMAN. They know whether they want them, how hungry they are for them.

Mr. MOLITOR. Yes, sir.

The CHAIRMAN. And it is easy for them to meet a situation through the adoption of any system. I can not see that it is going to aid particularly in the export of our produce abroad. There are so many other factors that appeal to me, let me say, much stronger, that I can not give very much weight to your judgment along that line.

Mr. MOLITOR. Do you realize that you have knocked the bottom out of the metric system in this bill. You do not ask anything there that is a hardship on anybody as you admit it is now.

The CHAIRMAN. I am clinging to your economic proposition.

Mr. MOLITOR. Yes, sir. If, on the other hand, it will work and become a benefit to the vital industries of the country, even though some people do not get any direct benefit, then would it not be wise legislation?

The CHAIRMAN. I have no quarrel with the system.

Mr. MOLITOR. I understand. I am answering your question.

The CHAIRMAN. I am interested in the method to be employed and when and how it shall be brought about.

Mr. MOLITOR. If we were compelling people to manufacture their goods in metric units, that would be a different thing. That would disrupt our industry very extensively, and it is just as well to leave it to the manufacturer to select his field of operation in regard to foreign trade, and if he so chooses manufacture a line of goods suitable for that foreign trade, in metric units. That has been done by the leading opposition to the metric system because they find it profittable to put out two lines of goods instead of one. Your bill does not touch that subject at all.

The CHAIRMAN. That is quite true. Is not the cost to the country—and when I speak of country I mean individuals—going to be very considerable in changing from one system to the other?

Mr. MOLITOR. The change involved in our own factory, where we employ about 200 men, was something like $75. If that expenditure could not be returned as a profit to the various profit-sharing individuals of the concern, then it was money wasted, was it not. But I do not think anybody would consider it that way. They consider it money well spent for the results accomplished.

The CHAIRMAN. Discussing that problem I have a letter dated October 24, 1921, calling my attention to this bill, and from it I read this extract:

"The American Railway Express Co. is engaged in the general express business throughout the entire United States, and has more than 100,000 scales located at about 28,000 agencies. If the metric system is adopted and the company is required to change all of its scales to the metric type, the estimated expense would be more than $1,000,000. If the change is not to be made until 10 years from date, or some other future time, that fact would not minimize the burden upon this company because the change would have to be made at one time so that all of the scales could be of the same type."

Of course, that is one institution.

Mr. MOLITOR. Yes; that is one institution. Now, in the first place that statement is not true, because it leads you to infer that all those scales will have to be thrown out and replaced by new ones, which is not the case. An expenditure of may be two or three dollars on each scale will do the trick. That estimate is based on absolutely discarding the old scales and replacing them with new ones.

The CHAIRMAN. I will put that letter in the record.

(The letter referred to reads as follows:)

AMERICAN RAILWAY EXPRESS CO. (INC.),
LAW DEPARTMENT,
New York, October 24, 1921.

THE MANUFACTURERS' COMMITTEE,
United States Senate, Washington, D. C.

GENTLEMEN: Referring to Senate bill 2267 to fix the metric system of weights and measures as the single standard of weights and measures for certain uses, which I understand is now pending before your committee, I desire to call your attention to some considerations in connection with this bill with respect to its effect upon this company.

The American Railway Express Co. is engaged in the general express business throughout the entire United States, and has more than 100,000 scales located at about 28,000 agencies. If the metric system is adopted and the company is required to change all of its scales to the metric type, the estimated expense would be more than $1,000,000. If the change is not to be made until 10 years from date, or some other future time, that fact would not minimize the burden upon this company, because the change would have to be made at one time so that all of the scales could be of the same type.

If the company endeavored to replace old scales as they become worn out this would result in a dual system of weights and measures, which would cause great confusion and would seem to be practically impossible of successful execution. It would also be necessary to train the employees in the use of the metric system, and this would involve a very heavy expense.

Section 5 of the bill makes it possible that weights or measures in connection with Government business may be changed before 10 years expires. This company is now charged with the duty of collecting a transportation tax based upon the charges which in turn are based upon the weight of shipments, thus it is seen that its connection with the Government requires a uniform standard in all of its transactions, and if it were required to have one standard for its regular business and another standard for its business transacted for or with the Government, this also would result in a dual system of scales which would cause great confusion, delay, loss, and expense in the transaction of its business.

While the transportation tax itself might not have this result, and that tax may be repealed, nevertheless it is always possible that some other requirement may be adopted by the Government which would result in a dual system being necessary in the company's scales and system of weights and measures.

To change the company's present system of weights and measures would necessitate the issue of new rates and instructions and a new sytem of accounting at an enormous cost, which could not very well be estimated in advance.

This is a very critical time for the transportation business of the country, and every item of expense in connection with it should be very carefully considered before the burden thereof is placed upon it, because it has a direct effect upon the transportation rates, which are so vital to the prosperity of the country.

It seems to us that the expense which will result not only from the purchase and installation of a new system of weights and measures, but also from the confusion, errors, etc., which will undoubtedly result therefrom should not be placed upon the transportation business at this time, and we feel that the future of the business should be more certain than it is at present before any future burdens are provided for.

On the whole, the possibility of the enactment of legislation changing the entire system of weights and measures is a very serious thing to this company, and we know that your committee will give very earnest consideration to the effect upon this company, as well as upon other transportation companies similarly situated, and we sincerely trust that your committee will decide not to favorably report any bill of this nature.

Yours, very truly,

H. S. MARX,
Assistant General Counsel.

Mr. MOLITOR. Computing scales, such as are used to-day in most of the retail establishments, groceries, meat shops, and so on, can all be changed at an expenditure of perhaps 25 cents to a scale, because it simply means taking out the diagram that is in there and replacing it with another printed diagram. Measuring devices used for measuring leather would be the same way. Two or three dollars would cover the expense of measuring leather metrically or in feet.

It is just exactly overstatements of fact of that kind that we have to combat. It is unfair. We are asked to put ourselves out and fight something that does not exist. In other words, we are fighting a myth.

I have letters here. I can show you the type of letter that is being circulated. I think I can show you something that is along the same line, to show you how the subject is being handled by antimetric propagandists [handing a letter to the chairman]. I consider that a threat to the individual, that if he does not oppose the metric system something is going to happen to him. That is the kind of propaganda that we are up against.

Here is another interesting incident. Here is the American Society of Civil Engineers, where Dr. George F. Swain, as a member of a committee on the advisability of the adoption of the metric system reports and advises that it does not agree with the policy of enforcing by legislation the use of the metric system in industry. Since no such legislation is contemplated, his advice to that society is altogether beside the point. But it has this effect on the society, that it is an adverse criticism of the metric system.

In January, 1908, I was a member of a committee composed of three members that submitted a report on the status of the metric system in the United States. That report was accepted and placed on file and presents both sides of the argument. It simply discusses the status without recommendation.

There are other institutions like the American and also the Canadian standards committees that are at work. They have also been receiving literature which is calculated to scare them by giving the impression that contemplated legislation makes it necessary to stipulate sizes in the metric system. As we have repeatedly brought out here to-day, that is not the case.

I have a paper which I would like to submit as a brief discussion of the whole problem from both sides. It leaves the reader to draw his own conclusions. If the chairman permits, I would like to submit this little abstract of a complete discussion of the problem, considering both sides, pro and con.

The CHAIRMAN. Yes. I think probably it would be valuable to the committee.

Mr. MOLITOR. I would like to say a few words about that. That was introduced in the last three years, and in that time has been rewritten perhaps 10 times. It is the result of experience covering a period of over 30 years, and I think it ought to have some weight with your committee. If it could be gotten into the printed records, no doubt you will find it of great help in explaining the situation among Members of Congress and Senators.

The CHAIRMAN. It will be printed and made a part of the record.

(The paper referred to is here printed in full, as follows:)

The Metric System of Weights and Measures.

[By David A. Molitor, C. E., member American Society of Civil Engineers, Engineering Institute of Canada, Washington Academy of Sciences, civil and consulting engineer, 1596 Bewick Avenue, Detroit, Mich.]

INTRODCTORY.

At this time of world reorganization, when all peoples of the earth are intensively occupied with the preparation for permanent peace, conditioned essentially on just and friendly international commercial relations, the universal adoption of a uniform system of weights and measures becomes one of the most important issues of the day.

National reorganization means nothing less than national housecleaning. It means to rid the Nation of inefficiency, excessive overhead, and lost motion, in so far as our national ambition and genius will permit, and it means that we introduce scientific methods to supplant obsolete and costly ones, even at a temporary inconvenience or possibly increased cost for installations.

Every reform movement and every institution under which we live and of which we are justly proud originally came into being through the labors of minorities. Although majority rule is being recognized as the corner stone of democratic government, it is wise to remember that even a democracy despises minorities at its peril.

Every reform movement initially meets with assault from many directions until it becomes thoroughly established. The well intentioned, the shortsighted, the timid, and the ignorant, all will criticize. Those whose private plans are seemingly interfered with will opose with specious reasoning. The vicious will attack both secretly and openly. Even the lethargy and disinterestedness of those who are won over serve as a deterrent.

It should not be necessary to apply the slow and costly process of educating the people to the point where they will demand that their legislators will sanction the adoption of the metric system. Our lawmakers should be only too eager to grasp the golden opportunity of instituting such an economic reform measure, merely on the oft-repeated recommendations of our governmental scientific bureaus. However, the fear of sacrificing political patronage is ample reason for delaying action until the constituency becomes sufficiently enlightened to clamor for relief from our antiquated system. This condition is one of the weak spots in our present methods of achieving progress.

The recent world strife, whatever its immediate causes may have been, undoubtedly originated in the race for trade supremacy in which the metric nations gradually displaced their nonmetric rivals, England and the United States.

With these preliminary remarks we may safely assume that our subject is presently entitled to the fullest consideration and widest publicity. If we can disprove the arguments which certain antimetric propagandists would have one believe, then in fairness to ourselves, our country, and our progeny let us apply our best efforts to the furtherance of this great reform.

HISTORICAL.

The general scope of our subject and its history would comprise a large volume, should any attempt be made to present a complete history of the metric system, and those who may be interested in this phase of the matter will do well to apply to the United States Bureau of Standards at Washington, D. C.

DESCRIPTION OF THE METRIC SYSTEM.

The United States Bureau of Standards is the custodian of the duplicate platinum-iridium meter bars and kilogram weights furnished to the American Government in 1899 by the International Bureau of Weights and Measures. These serve as the fundamental standards of length and weight for all units of measurement in the United States.

The fundamental unit of the metric system is the meter, which is the unit of length and is equal to 39.37 inches. The units of weight and of capacity were derived from the meter and are known respectively as the gram and the liter. All other units are decimal subdivisions or multiples of these three. The units of length, volume, weight, and capacity are conveniently interrelated as follows: One cubic decimeter of water at 4° centigrade equals 1 liter

and weighs 1 kilogram, or 1 cubic meter of water measures 1,000 liters (1 kiloliter) and weighs 1,000 kilograms or 1 metric ton.

Corresponding relations between our United States units would be 1 cubic foot of water equals 7.480 United States gallons, equals 6.231 imperial gallons, equals 62.42 pounds avoir.; 1 United States quart of water equals 57.75 cubic inches and weighs 2.083 pounds avoir. at 35.8° F.

Besides these units, we have three different kinds of pounds and dry, liquid, and imperial quarts to deal with.

The metric measuration tables are formed by combining the words meter, liter, and gram with the six numerical prefixes as in the following table:

Prefixes.	Meaning.	Length units.	Capacity units.	Weight units.
1. Kilo	1,000	1 km.=10 hm	1 kl.=10 hl	1 kg.=10 hg.
2. Hecto	100	1 hm.=10 dkm	1 hl.=10 dkl	1 hg.=10 dkg.
3. Deka	10	1 dkm.=10 m	1 dkl.=10 l	1 dkg.=10 g.
Unit	1	1 m.=10 dm	1 l.=10 dl	1 g.=10 dg.
4. Deci	$\frac{1}{10}$	1 dm.=10 cm	1 dl.=10 cl	1 dg.=10 cg.
5. Centi	$\frac{1}{100}$	1 cm.=10 mm	1 cl.=10 ml	1 cg.=10 mg.
6. Milli	$\frac{1}{1000}$			

The square measure is derived from the length measure by substituting 100 for 10 in the column of length units and employing the additional designation "square." Similarly for cubic measures, where the relationship becomes thousand fold. For land measures, the unit is the *ar*[1]=100 square meters, and this unit is similarly combined with the above prefixes to obtain the complete mensuration table.

The various decimal multiples and subdivisions of the metric units have received names merely for convenience and completeness of the system. These designations afford a choice between seven decimally related units for scientific purposes, while in the ordinary walks of life only a few are used because any quantity can be expressed in terms of any single unit as a whole number followed by a decimal. Thus, it would be impractical to state a distance in kilometers, hectometers, dekameters, meters, etc., as the same distance can be expressed in any one unit by properly placing the decimal point. In the English and United States units the reduction of compound or mixed denominate numbers to single units involves many superfluous multiplications and divisions, and constitutes a one-year course in arithmetic.

The general public would employ only a few of the metric units for commercial uses. The kilometer and the meter are the common units of length, used exactly as we now use the mile and yard. The kilogram is the usual unit of weight, although the half kilogram is frequently called a pound. The liter is the unit for liquid measure and the ar for land measure. Thus we would have kilometers, meters, kilograms, liters, ars and cubic meters, corresponding, respectively, to our present terms miles, yards, pounds, quarts, acres and cubic yards.

The metric system is so simple in theory and practice that any one of average intelligence can learn it in one hour. In a few days it is as easy to think in the metric system as in our own. Estimating is facilitated by remembering that the meter, liter, half kilogram, and metric ton are each about 10 per cent larger than the corresponding United States units yard, dry quart, pound, and short ton. The United States liquid quart is about 5 per cent smaller than the liter. For accurate conversions between the two systems Circular No. 47 of the United States Bureau of Standards should be used.

LEGAL STATUS OF THE SYSTEM IN THE WORLD.

The metric system is obligatory in the following 35 countries, comprising over 437,000,000 population: Argentina, Austria, Belgium, Brazil, Bulgaria, Chile, Colombia, Costa Rica, Cuba, Denmark, Finland, France and colonies, Germany, Guatemala, Holland and colonies, Honduras, Hungary, Italy, Kongo, Luxemburg, Mexico, Nicaragua, Norway, Peru, Portugal and colonies, Rumania, Salvador, Serbia, Siam, Spain, Sweden, Switzerland, Tunis, Turkey, and Uruguay.

[1] This spelling is adopted in preference to the French are to avoid confusion with the English verb of the same spelling.

The Japanese Parliament recently voted a law making the metric system obligatory, the law to go into effect in April, 1922. In China it will come into force in 1923. In Russia the system has been taught in all schools for many years and is now the standard for commercial transactions.

This brings the total, who may be classes as prometric, to over 800,000,000 people.

The metric system is legal but not obligatory in the following eight countries: Bolivia, Canada, Egypt, Great Britain, Greece, Paraguay, United States, and Venezuela.

The English attitude is indicated by the fact that in 1897 the metric system was made legal, and in 1900 there were 96 members of Parliament in favor of a compulsory metric bill. In 1906 the metric votes increased to 414, while in 1907 the bill lacked only a few votes of passing. The Governments of Australia, Canada, South Africa, and New Zealand have declared themselves strongly in favor of the reform.

To summarize these facts, it appears that the whole world is practically metric, excepting only the United States and the British Empire. These two powers are now seriously considering compulsory adoption, thus fully admitting the failure of permissive legislation.

LEGAL STATUS OF THE SYSTEM IN THE UNITED STATES.

To a certain extent the metric system is the adopted standard of the United States, because most of the American standards are at present derived from the metric, and all electric units and the coinage are entirely metric.

However, with all the Government regulations and permissive laws, our metric progress has been very slow. We have not even advanced to the stage where all public school attendants receive proper instruction as in Russia prior to the war.

The right to establish a system of weights and measures is vested in Congress by the Constitution of the United States, but, aside from legalizing the system by the act of 1866, that authority was exercised only with respect to the coinage, electric units, and postal rates, and in making the system obligatory in Porto Rico in 1899 and in the Philippines in 1901.

The United States Congress, which has considered many measures looking toward the adoption of the metric system, has given more weight to the petty objections of a few money interests than to the concerted arguments and efforts of the scientific world. All this in the face of favorable recommendations by the committees on weights and measures on the several bills considered at various times.

OBJECTIONS TO THE ADOPTION OF THE METRIC SYSTEM.

1. Expense and inconvenience attending any change in our present units of measurements.

2. One additional system. It is claimed that the adoption of the metric system would mean simply one more system to the many already in use. This is precisely the condition which has prevailed for over 50 years under the permissive law of 1866, and which it is so desirable to overcome by the adoption of one system which will fulfill all human requirements, thereby relinquishing all other systems to the relics of the past.

3. Antagonistic public opinion, brought about by unwarranted efforts on the part of some manufacturers and journalists who believe that their immediate pecuniary interests might suffer. Such action, prompted largely by gross ignorance of the whole subject, is distinctly harmful to the future welfare and prosperity of the Nation, resulting not only in future monetary loss but retarding the general progress of the world.

Other reasons may be advanced by those who have not yet discovered just what the system stands for, but they could probably be classified under one of the above headings.

REASONS FOR THE ADOPTION OF THE METRIC SYSTEM.

1. Simplicity of the relations existing between the units of length, area, volume, and weight. This obviates effectually all the laborious manipulations growing out of complex relations, and saves an immeasurable amount of time

and labor in all scientific and commercial pursuits. The system bears the stamp of efficiency.

2. Uniformity of all units of measurement throughout the world following the adoption of the system by England and the United States. This feature is specially calculated to facilitate international commercial relations so vital to our manufacturing industries. Uniformity is so far-reaching in its effects that it may well be called fundamental to any future international league as the only universal working tool of world commerce.

3. International standards: The unalterable and perfect prototype standards which exist in all civilized countries make it the accepted standard for the world. Therefore it matters not what other units might exist; they must all eventually be expressed in terms of metric units.

4. One mensuration table would answer all purposes in all walks of life and in every nation on the earth instead of the thousands of units which are or have been in use during past ages. School children would have to learn only one set of units, which would carry them through life, instead of the many absurd and complex mensuration tables which they must now memorize, only to be forgotten before their life work is undertaken.

5. The decimal relation between the metric units offers an inestimable advantage in all scientific work and the arts. Though this is mentioned last, it is none the less important, since civilization is measured by the progress in arts and sciences and not by prejudices and whims of those who are tied irrevocably to the past.

THE METRIC SYSTEM IN EXPORT TRADE.

It is a universally acknowledged principle of trade that the purchaser reserves to himself the right to stipulate what he wants and when he wants it. The salesman must meet these requirements or lose the business. While it may be good salesmanship to win out under adverse circumstances, yet this rarely leads to enduring relations with customers.

We have all observed the results of overproduction and periods of glutted markets, which are bound to return.

Whom do we expect to serve with the enormous output of this country in ever-increasing excess over home demands or consumption? Aside from English customers, they will all be from metric countries.

Germany adopted the metric system in 1872 after her military victory over France, and thereby laid the foundation for her later commercial victory. Shall we heed or ignore this lesson at the present turning point in international reorganization?

The metric system must be regarded as the dominant factor in securing foreign trade if the United States hopes to attain the position to which she is rightfully entitled. America must sell her goods in foreign markets in metric measures and not according to our antiquated methods.

Most people believe that the United States has a community of interest with England against the metric world. This is true in name only, while the fact is that England long ago abandoned the Troy pound, and the United States is still using a gallon and a bushel measure, long since discarded by England, so that, with respect to all liquid and dry measures and the ton weight, the United States practice already differs widely from the English. This disparity is almost as serious an obstacle to commercial interchange between our countries as if we were confronted with a metric country. The further fact that English exporters are using the metric system very extensively is an equally cogent reason why American exporters should do the same.

In the textile industry one exponent of old-fashioned ideas persists in publishing some most adventurous tales of the metric system and arrives at very extraordinary conclusions, calculated to frighten the public.

Where commercial relations with foreign countries bring about conflicting conditions, a dualism of units seems a necessary but temporary evil. Thus, where raw products are so largely furnished by America and England, and the manufactured products from France, Switzerland, Germany, etc., are sold back to the former, such a condition will continue to exist until the metric system becomes universal.

Many commercial interests involved in foreign trade are now supplying catalogues and handbooks in which equivalents are given in both metric and United States units, indicting that the metric system is being extensively used in reaching out after foreign trade. *Strangely* enough, most of these catalogues emanate

from precisely those mechanical trades which formerly waged the most strenuous opposition to the metric reform. The mere fact that such concerns have entered upon metric manufacture and trade proves that this is both possible and profitable; so what ulterior motive could further prompt their action?

Of all comparatively recent cases, where manufacturing concerns have boldly plunged into metric units to save themselves from partial or entire elimination from export trade to metric countries, few, if any, have regretted the step. Recent reports show that a host of English manufacturers have become desperate in waiting for legislative relief from the dual permissive system, in favor of compulsory metric reform, and have voluntarily adopted the metric system.

In 1907 the Baldwin Locomotive Works built 20 locomotives from metric drawings for the French Government. This experiment developed such satisfactory results that during the war the same concern built 100 more locomotives to metric dimensions.

We might continue indefinitely reciting similar facts and yet fail to convince a few; but will it ever be possible for the people of this country to unite on one harmonious system of weights and measures for the enduring benefits of all mankind? While such a thing has never been known in the past there is still a possibility of accomplishing the unexpected, provided we all lend a helping hand.

TRANSITION PROBLEMS.

Discussions of this subject are often unduly lengthened by a mistaken idea that units of money, time, angular measure, and thermometry are part of the metric system. The size of the earth is also dragged into the question, because the original meter was said to represent one ten-millionth part of the earth's quadrant.

It is also regrettable that some persons will persist in frightening the public by exaggerated guesses at the cost involved in the transition. We are told that practically all machinery, tools, screws, gauges, and templates would have to be discarded, even that gas and water pipes would have to be torn up. These prophets would do well to expose the proponents of such ridiculous things rather than waste their own time in computing the costs involved. The metric movement was never backed by lunatics and fanatics; hence the public need not entertain any doubts regarding the reasonableness of the proposed change.

In the language of Dr. S. W. Stratton, director of the United States Bureau of Standards: "No one proposes to change the sizes of useful things, but merely to designate them in a language of measurement known to the whole world."

The manner and extent to which the vital industries of the country will be affected by changing over to the metric system will now be briefly considered.

To remove the apprehensions of honest objectors who claim that the cost of making the change would be very severe, particularly on manufacturers of tools and machinery, it is merely necessary to point out that metric legislation, in practically every country and as proposed for England and the United States, is only concerned with transactions of sale, while manufacturers are free to use any system they desire in their workshops. However, the adoption of the new weights and measures in commerce will make it possible for any manufacturer to operate his workshop metrically whenever he finds it to his own interests to change over. The exclusive use of the metric system in workshops has always resulted in immense benefits. Considering the multitude of production operations involving the use of weights and measures, it is most astonishing that our cumbersome, archaic methods have so long survived.

Where it becomes desirable to translate English to metric units in trade catalogues or on drawings by the use of conversion tables or otherwise, it should be remembered that every weight or dimension is to a certain extent nominal, so that a definite tolerance is permissible in every case. It is ridiculous and frequently dishonest to overstate the accuracy of any measured sizes and betrays improper use of conversion tables when decimals are carried out to a ficititious degree. For example, where dimensions are given to the nearest one thirty-second or one twenty-fifth inch the metric equivalent should be expressed in whole millimeters, thus $2\frac{1}{32}$ inches equal 51 millimeters. On the other hand, where a high degree of accuracy is necessary and ten-thousandths of an inch are called for the metric size should be stated to the nearest 0.01 millimeter, thus 1.2487 inches equal 51.72 millimeters.

In many cases gauges are designated by abstract numbers, as for wire, sheet metal, screws, etc. Here the number governs the size irrespective of any particular unit of length. There are at least five different wire and sheet-metal

gauges which it would be a blessing to see replaced by one rational metric gauge.

A pattern or template always retains its value, whether it was made to inches or to millimeters, and when the dimensions on a drawing are once converted the difficulty is overcome without changing the thing itself.

Regarding structural shapes and plate thicknesses, the metric scale in millimeters without decimals answers every purpose, since the usual tolerance for mill variations is at least one thirty-second inch. In like manner tables of round, square, and other rolled shapes, also pipe sizes, can all be expressed in whole millimeters and be within actual trade limits, so that the change would be one of name only. Rolling-mill machinery would all be usable until worn out, and slight changes could easily be made at appropriate times. In fact, as early as 1906 several German, French, and Belgian rolling mills manufactured rails and structural shapes of American standard sections and quality; hence it should be equally feasible for American mills to roll metric sizes without change in present equipment.

Samuel Vauclain, vice president of the Baldwin Locomotive Works, referring to past experience in building French engines, stated that no greater difficulty was encountered, that the work was easier, and that they could change to the metric system or use both systems without incurring any appreciable extra expense. Were we all using the metric system, it would, in his opinion, be much more convenient to the workmen, and our errors would be materially lessened.

In machine-shop practice designs are changed at such frequent intervals that dimensions could be easily converted or altered without extra expense. In many cases certain sizes and types of machines are arbitrarily discontinued, or repair parts are no longer procurable, so that new machines must be purchased. Perfectly good machines are often discarded as a matter of efficiency, owing to newer and better types being produced. Hence little if any pecuniary loss to manufacturing concern need be incurred directly as a result of the change to metric sizes.

There are reasonable objections to any sudden changes in screw threads, and it may require several years before the English threads can be displaced. Some American catalogs give eight systems of screw threads, including three metric and five nonmetric systems, showing how desirable it would be to abolish some of them. The English threads remained standard in France and Germany until about 1900, at which time the metric thread was officially established. In the course of nine years the new metric thread became the most extensively used in the mechanical industries of continental Europe. Metric taps and dies are already offered for sale by a number of prominent American manufacturers and can be acquired without extra cost whenever replacements become desirable. Screw-cutting lathes can be easily rigged to cut metric threads merely by the introduction of a special gear.

The present divisions of the circle are already universal, and hence require no change. The decimal quadrant affords no advantage because all mathematical processes involving angultr functions must be solved by logarithms or natural trigonometric functions.

All surveying instruments will thus remain unaffected. The cheaper accessories, like leveling rods, tapes, and scales, which wear out with sufficient frequency, can be replaced by metric tools whenever desirable.

Ordinary weighing scales can be altered to weigh metrically, either by changing the graduated limbs or by supplying different counterweights. In the better class of computing scales the only change necessary would be to supply new printed diagrams. Chemical scales are practically all metric at the present time because no chemist could well afford to calculate analytical results in apothecary weights.

Leather measuring machines, which are quite costly affairs, can be altered to measure metrically simply by replacing the dial. A convenient metric unit for measuring leather is the cuirmeter, which is one-tenth square meter or 1.076 square feet.

Drawings made to metric scales always bear a simple ratio to actual sizes. Common ratios are 1 : 2, 1 : 10, 1 : 20, 1 : 25, 1 : 50 and 1 : 100. Ratios differing by multiples of ten are all taken from the same graduation. About six different graduations will supply practically all scales in use.

In the publication of new books it is almost necessary to supply both English and metric data at the present time. Older books can be changed when revisions become necessary.

It is a fact that during the *past* hundred years every nation which changed its system *of weights and measures* adopted no other system than the metric,

and no nonmetric country is at present contemplating any change other than to the metric system.

The exclusive use of the metric system must be regarded as a step toward national economy which no good citizen can afford to oppose.

Reg.nald McKenna: "No doubt, the initial institution of the decimal system would cause dislocation, but once established the saving of time and labor could not fail to bring rapid compensation."

Thomas A. Edison: "I have for years been in favor of the adoption of the metric system and would like to see it substituted for the present jumble."

Henry Ford: "We heartily approve of any step toward the adoption of the metric system in the United States. It appears there is no time better than now."

Andrew Carnegie: "The metric system of weights and measures is one of the steps forward that the Anglo-Saxon race is bound to take. Our present weights and measures, inherited from Britain, are unworthy of an intelligent nation to-day."

Hon. A. J. Balfour: "There can be no doubt, I think, whatever, that the judgment of the whole civilized world, not excluding the countries which still adhere to the antiquated system under which we suffer, has long decided that the metric system is the only rational system."

In speaking of the metric system, Theodore Roosevelt said: "We must have it."

REQUIRED LEGISLATION.

Much has been said and written to prove the fallacy and utter worthlessness of permissive laws, though the enactment of this class of legislation is the fullest extent to which the United States Congress has assumed responsibility.

The general presumption that we have a right to do anything which is not forbidden would naturally mean the uselessness of all laws which merely permitted. In other words, it is folly to pass laws to permit people to do something as a matter of convenience to themselves.

Until we will simultaneously adopt the metric system and thus make commercial interchange in the one system possible, it will be quite impracticable for any individual to avail himself of the privileges of any permissive laws unless he wishes to enjoy a rather complete isolation.

It is easily seen that the permissive laws are doomed to failure, and they have proven so in all countries where they have been tried. The United States has suffered over 50 years and England about 20 years under such laws. Both countries are just beginning to see the light as the era of compulsory legislation is dawning.

People frequently say that they are opposed to compulsory laws, thus practically admitting their opposition to any laws involving punishment of crime and fraud.

One or two years under an obligatory act would accomplish the introduction of the metric system, while a century under permissive laws is a century lost to progress.

To wait for public demand in matters of this kind is an exposition of weakness and shows a lack of progressiveness. A mere authorization to use a simple and rational system of measurements as a substitute for a much less perfect system long established by usage, is not sufficient to bring about a reform. In fact, in commercial affairs, the buyers and sellers are dependent one upon the other in such a manner that, unless one side completely dominates the situation, neither is able to take the initiative toward the adoption of the improved standards. It is therefore necessary to make the new measures obligatory.

While the common people certainly can not be denied a voice in this matter, yet those having the greatest labors to perform should also render the determining decision in choosing the system of units. It matters little whether the farmer sells in bushels, hectoliters, or kilograms; the grocer in English pounds or half kilograms, which are called metric pounds. The dry goods merchant can sell in yards or meters with equal rapidity.

Aside from a slight temporary inconvenience to shopkeepers, it will be in every case merely a matter of price, and those having goods for sale will very soon adjust the scale of prices.

Throughout the commercial world the great majority of manufactured articles would remain absolutely unaffected by a change in units of measurement, because we are not interested in sizes so much as in the rule or scale with which we measure sizes. Since commercial sizes are nearly always nominal,

hence, by allowing for a certain tolerance, a suitable metric dimension can always be found which will satisfy all requirements.

The chief deterrent factor in this country appears to be a lack of appreciation and understanding of the true merits of the metric system, which can be entirely overcome by education.

The metric system is no longer an experiment, but has stood the test of time and is constantly growing in favor, despite the most energetic opposition waged by paid propagandists representing certain branches of industry.

Who would return to the English monetary system after having used decimal money? What metric country in all the world would be willing to give up the metric system after having experienced the great advantages accruing from its adoption?

We must acknowledge a marked lack of energy and progressiveness for our Nation when we reflect on the slow progress which has crowned the efforts of those striving to get such a worthy measure on our statute books. The same statement applies to England. We have jointly legalized the metric system, but have defeated its real usefulness by not making it the only legal system.

It is a great mistake to agitate in favor of a long transition period. This would mean a long period of watchful waiting, with the outcome that nobody would do anything toward adopting the new system until the time fixed had expired. Such a law would be forgotten before it ever became operative. The United States Government had this experience when the railroads were ordered to equip all freight cars with automatic couplers and continuous brakes. The railroads did nothing toward complying with the law until the allotted five years had expired. The time was then extended two years and seven months, during the last year of which most cars were equipped.

Our commercial supremacy among nations will depend largely on whether we act first and let England follow, or whether we will content ourselves with playing the usual second fiddle.

Every live business man should see and appreciate this position, and should exercise every possible means to impress upon our lawmakers generally the vital importance of immediate action.

The business world of to-day has no room for men who object to taking the trouble involved in the transition, which will represent only a fractional part of the trouble measured in errors and annoyances continually suffered with the present mongrel system.

The immense efforts in time and money thus far expended, combined with the united brains of the scientific world, to produce a system primarily intended to satisfy all human requirements, has resulted in the introduction of the metric system into all civilized countries excepting England and the United States. It would be a lasting and unpardonable disgrace to obstruct the ultimate achievement of this grand undertaking, the international unification of standards of measurement.

Prejudice, indifference, and adverse lobbying have so far constituted the only reasons why the United States Congress has not made the metric system the only legal system in the United States. The question has occupied the attention of Congress at frequent intervals ever since the time of Washington, and John Quincy Adams strongly favored the system.

The great question of to-day is, Shall we segregate the English-speaking nations into a balance of power erected on an antiquated system of mathematics; or shall we join the world of nations with universal units of weights and measures far more essential to satisfactory trade relations than uniformity of money, language, or religion?

The great significance of the proposal to adopt the metric system hinges on many details which may not always be apparent. For the ordinary man, engrossed in matters that concern chiefly himself and his own community, the subject is too vast and its possibilities too far-reaching to be easily comprehended.

Most objections raised against the introduction of this eminently practical system are trivial. It is, therefore, unfortunate that such objections should dim the vision of our people. It is unfortunate, too, that the cost of changing over can be so easily overstated, and by our opponents be so glibly utilized to keep inert a goodly number of leading business men who can scarcely afford to ignore the splendid advantages offered them.

If we are to understand the advantages of the metric system, we must certainly employ vision. We need the vision that looks beyond to-morrow and the State line; the driving power that impels us to undertake economic measures for our future betterment.

The benefits to be derived from the adoption of the metric system would be enough to warrant the undertaking, and the cost of the achievement, if rationally analyzed, would not prove a prohibitive factor, although presently magnified by our opponents in their frantic efforts to catch at a straw.

The fact that in private enterprise, both in England and in America, many have availed themselves of the great advantages accruing from the use of the metric system should be a sufficient rejoinder to any objection on the basis of cost. Private enterprise does not plunge heedlessly into such ventures unless it is a paying investment.

Hence, we are not praying for to-day, or for a group here and there, but what we hope to achieve is calculated to benefit untold millions in the years to come.

The CHAIRMAN. I suppose that really crystallizes the whole subject as you understand it.

Mr. MOLITOR. Yes, sir. I have also discussed in there the transition period and how it would affect different industries.

The CHAIRMAN. Very well.

Mr. MOLITOR. Also what relation it has as bearing on foreign trade. If there are any other questions you care to put to me, I will attempt to answer them to the best of my ability. I came a long ways to attend this hearing, and I want to be fair and square to both sides and to everybody concerned.

The CHAIRMAN. You have been.

Mr. MOLITOR. I simply pray, for the benefit of our present race and of the race to come, that you adopt this system as an economic advantage. The longer we put it off the greater the difficulty will be in making the change, because more people will be involved.

There is another little side issue to this, and that is you might ask what effect would this change have on somebody who does not transact any business. There are people in the world who really do not transact any business one way or another. How would they be benefited by this legislation? To be honest with you, I would say they would get absolutely no benefit from it, nor would they suffer any harm from such legislation. That is the crucial point I want to make. While some people might not receive a direct benefit from the measure as contemplated—and I do not wish you to infer that we want anything more than that; that is enough—yet the prime movers of the country are the ones that will receive the benefit, and indirectly the consumers, because if our large manufacturing institutions are better equipped to manufacture, if they can save money, and I doubt whether there is any manufacturing institution in the United States to-day that could not more than save the cost involved in making the change in one year by the advantages that would be derived as profits—I do not think such an institution exists that could not accomplish that and thereafter each year net a very nice profit or be able to reduce the price of its goods—then every human being in the United States will be benefited, whether he be farmer, doctor, lawyer, or what he may be.

So that the indirect benefits to the great majority numerically will be for all time to come and undoubtedly will amount to a material sum. That is the principal advantage I would expect to hold out in talking to an audience comprised of members of a rural community. I have addressed rural communities on this subject, I have addressed manufacturers on this subject, I have addressed bodies of business men like the retail druggists' association, things of that kind; and while I was told beforehand that there were people in the audience who were very much opposed to the metric system, and would not listen to it under any circumstances, who had even written newspaper articles opposing it, I said, "All right; if I can not convince them, I am no good. I believe that I have the logic on my side." In every case when the meeting was turned over for an open discussion there were very few questions asked. In one case where I was threatened with a very severe battle the man took his hat and walked out, and he was an exponent of our opposition.

Is there anything else, Mr. Chairman?

The CHAIRMAN. I think not, as you have covered the ground so thoroughly. You have made a very excellent presentation of the subject, and the committee is indebted to you—to both of you gentlemen who have appeared to-day.

Mr. MOLITOR. I hope it don't end here. If there is anything that I can do in the future I hope that you will give me that privilege and call on me.

The CHAIRMAN. Thank you. The committee will adjourn until to-morrow at 11 o'clock.

(Whereupon, at 12.40 o'clock p. m., the subcommittee adjourned until to-morrow, Tuesday, October 25, 1921, at 11 o'clock a m.)

THE METRIC SYSTEM.

TUESDAY, OCTOBER 25, 1921.

UNITED STATES SENATE.
SUBCOMMITTEE OF THE COMMITTEE ON MANUFACTURES,
Washington, D. C.

The subcommittee met, pursuant to the adjournment of yesterday, at 11 o'clock a. m., in the committee room, Capitol, Senator Charles L. McNary presiding.

STATEMENT OF MR. S. L. HILTON, PRESIDENT AMERICAN PHARMACEUTICAL ASSOCIATION.

The CHAIRMAN. Mr. Hilton, you may state your name, residence, and occupation: also, the experience you have had in a chemical line.

Mr. HILTON. S. L. Hilton, Washington, D. C.; president American Pharmaceutical Association; treasurer United States Pharmacopœial Convention, former member of its revision committee; member of the revision committee of the National Formulary. Both of those works, the United States Pharmacopœia and the National Formulary, are standards for drugs under the food and drugs act, and are so recognized all over the country. I am also a retail pharmacist, with very nearly 46 years experience, 32 years of which has been in one place in the city of Washington.

I want to say that the American Pharmaceutical Association has repeatedly gone on record favoring the adoption of the metric system. I was unable to bring a printed statement to that effect from our recent meeting held in New Orleans in the latter part of August, because our proceedings covering that meeting have not as yet been put in print.

Since our meeting the National Wholesale Druggists' Association have likewise unanimously gone on record, and Dr. Schieffelin, who appeared before the committee some time ago I felt should have filed with the committee a copy of a publication containing the main points with reference to that, showing the discussion and the position that was taken. That report also brings out what has been done in China and Japan with reference to adopting the metric system. This is taken from a copy of the Oil Paint and Drug Reporter, of October 4.

The CHAIRMAN. I think it might be of advantage to have this report placed in the record.

Mr. HILTON. That is why I brought it along, so as to present it and have it made a part of the record. I do not believe it is necessary to go into detail on the points covered by it, because if it is made part of the record the members of this committee will have ample opportunity to look it over.

The CHAIRMAN. That will be placed in the record.

(The extract referred to is as follows:)

"The annual meeting of the American Metric Association was held in the United Engineering Building in New York city on Monday, December 27, 1920, where it was presided over by the president, George F. Kunz. Another meeting of the same association was held in Cobb Hall, of the University of Chicago, on December 29 and 30.

"The examples, papers, and discussions at these meetings brought out more clearly the advantages which the more general use of the metric system would bring to the United States.

"Letters were received from the leading scale manufacturers, stating that they are ready to supply practically all of their scales either in the customary or in metric weights and at the same price. These companies pointed out that apart from their metric scales many of their scale-beams are graded to read pounds on one side and kilograms on the other.

"It was pointed out that the United States subsidiary currency and the nickel 5-cent pieces are legally defined in terms of grams. A new 5-cent piece weighs exactly 5 grams, and the 10, 25, and 50-cent silver pieces weigh one

gram for each 4 cents. Two Chinese pennies will balance one nickel. All of these coins may be conveniently used as weights in pocket metric scales.

"CHINA USES METRIC SYSTEM.

"A number of Chinese attended the Chicago meeting and the following interesting points were brought out:

"1. That both China and Japan had long ago officially adopted the metric system.

"2. That metric weights and measures were extensively and increasingly used and were replacing the various old weights and measures of the Orient. Even these old weights and measures were conveniently based on metric standards, and the old names were often used to express certain metric quantities. For instance, one Chinese ch' ih equals 32 centimeters, and one y ing consisting of 100 ch' ih equals 32 meters. Likewise, the Japanese kin is merely another expression for 600 grams.

"3. By far the largest engineering works in China, the Han Yang Iron & Steel Works, has from its beginning used nothing but metric weights and measures.

"4. It was the opinion of the Chinese present that while Americans did succeed in getting some business in China without the use of the metric system, they would be more helpful and successful if they dealt in terms of the metric system.

"It was estimated that at least 200,000,000 people in other countries will welcome trade with America on the metric basis.

"House of Representatives bill No. 15420, introduced by Representative Fred A. Britten, of Illinois, calls for the general use of metric weights and measures for commercial transactions 10 years after the date of its approval. This bill was considered at both the New York and Chicago meetings of the American Metric Association.

"The Britten bill allows the manufacture and sale of all articles for export in any weight or measure and does not apply to any contract made before the date at which the provisions of this act shall take effect.

"The officers of the American Metric Association for 1921 are George F. Kunz, president; William Jay Schieffelin, treasurer; Howard Richards, jr., secretary.

"The annual meeting of the association for 1921 will be held in Toronto, Canada, during the last week of December.

"JAPAN ADOPTS METRIC WEIGHTS.

"The Decimal Educator of June, 1921, which is published by the British Decimal Association, located at 229-231 Finsbury Pavement House, London, England, states that the Japanese Parliament has voted a law making the adoption of the metric system obligatory in Japan, which law will come into force in April, 1922. Also, that in Siam the system has been obligatory since 1912, and that in China it will come into force in 1923. The same quarterly journal states that the introduction of metric weights on the Chinese railways on January 1 occasioned no trouble at all. When the system had been in operation over a month not a single complaint had been heard. It was apparently easier to pick up new ideas in China than some anticipated it would be in England.

"The Malta Government on March 2 published a notice to the effect that under the weights and measures ordinance of 1910 the metric system will come into force in Malta on July 1, 1921. The weights and measures indicated in the import duties ordinance of 1917 have been replaced by those of the metric system.

"The Republic of Guatemala has adopted the metric system for all official purposes.

"At the January meeting of the British Chamber of Commerce for Switzerland, it was unanimously decided that the board of the chamber was in favor of the introduction of the decimal and metric system in the British Empire.

"An appendix to a memorandum drawn up for the consideration of the British national committee of the International Chamber of Commerce by Harry Allcock shows the present legal status of the metric system, and this demonstrates—

"(*a*) That the use of the metric system is already legalized throughout the entire commercial world.

"(*b*) That practically all the remaining countries where the use of the metric system is as yet only 'optional,' now show a marked tendency to transfer from the 'optional' group to the 'compulsory' group.

"(*c*) That the volume and proportion of British export trade with 'compulsory' metric countries has grown very rapidly since the war. This is not surprising when it is realized that all the European allies of England employ the metric system.

"The PRESIDENT. I think that most of us have a feeling that the metric system is the one that will be the system of the future. As to just when we can put that through, I do not know, but it would diminish our expenses very greatly if we could have the decimal system. There are many mistakes made in writing dozens, gross, etc., and if you could have 100s, 1000s, and 10ths, it would go a long way toward reducing these errors. I understand that the manufacturers of rubber goods are marking their product according to the decimal system, and this is being done very generally. I understand that Dr. Schieffelin is the treasurer of the American Metric Association, and we would like to hear from him."

Mr. HILTON. The supplies for the United States Government, and its departments in Washington, are looked after by a general supply committee and after all the awards have been made there is a schedule of supplies that is published, so that everyone has access to it, knows what the Government pays for things, what the usual supplies and so on are. On referring to that it will be found that, under drugs and medicines, the big majority of all the supplies for the Army, the Navy, the Public Health Service, the chemical supplies for the Bureau of Chemistry and the various other chemical laboratories of the Government, and the supplies for the apparatus that is used in those various chemical laboratories, are all in the metric system, giving dimensions if it is apparatus; if drugs and medicines, giving the quantities.

A little later on in my argument I want to point out, at the proper time, just what that means.

The CHAIRMAN. Instead of printing this schedue as a part of the record I think it would be the better plan, if you could do so for you to leave this in the custody of the clerk of the committee, so that it can be referred to and examined by the members of the committee at any time.

Mr. HILTON. Very well, Mr. Chairman; I will be glad to leave it.

In the pharmaceutical lines, Mr. Chairman, we are confronted with this proposition. We have three standards besides the metric system. We buy our suppies in the avoirdupois weight. When we sell our supplies over the counter, when the layman comes in and asks for something, we sell that by avoirdupois weight, but when we compound a prescription then we use an entirely different system. If it is a solid material we use the Troy system. In the avoirdupois system there is 437½ grains to the avoirdupois ounce. When we sell something on a prescription by Troy weight there is 480 grains to the ounce. The avoirdupois pound is 16 ounces; the Troy pound is 12 ounces. You can readily see how confusing that is. When we come to liquids we have still another ounce; we have an ounce of 455.6 grains, usually rounded off to 456 grains.

We are confronted with the proposition right there, when a physician wants a carefully prepared percentage solution, that we have got to take a solid material by one system of weights and a liquid material by another system of weights. There is a calculation right there dealing in fractions. So the pharmacist who understands his business, who has had scientific training, at once abandons the three of those systems. If he has a call for 1 ounce of a 5 per cent, 10 per cent, or 2 per cent solution, whatever it may be, he simply says 100 cubic centimeters, takes 2 grams if it is a 2 per cent solution, or he takes 5 grams if it is a 5 per cent solution, and he makes his equivalent quantity—25, 50, and so on.

But if we had just the one system, so as to eliminate all of those three different weights, it would simplify everything in all of our scientific work. When it comes down to drug assay or chemical assay for its purity, it is all done in the metric system.

So there has been one difficulty, that the absence of the use of just the one system has probably kept a good many out of doing certain scientific work that they otherwise ought to have done.

As to its simplicity, it has been stated time and time again. Stated briefly it is as the comparison between our system of money and the English system of money. I am sure that neither you nor any member of the committee would be willing to go to the pounds, shillings and pence to handle your cash.

All the scientific bureaus are required by law to use the metric system. The act of July 28, 1866, approved by the Secretary of the Treasury April 5, 1893, makes official for metal standards the use of the metric system. So that our present coinage system is in the metric system.

All foreign rates of exchange are based on the metric system. The United States Army, the United States Navy, the medical departments of each, and the Public Health Service, likewise, are compelled to use the metric system, and here are citations [indicating]. If the committee would like to have this publication of the Bureau of Standards, I will be very glad to leave it with you.

The CHAIRMAN. Thank you.

Mr. HILTON. You will find them marked. In connection with the work of the general supply committee there is a point that I want to bring out. All the manufacturers of chemical products in bidding for those supplies for the medical departments of the Army, the Navy, and the Public Health Service are compelled to bid on a metric package. What is the result? The result is this, they are not at the present time putting up those packages in the regular course of trade. They have got to have special packages, they have got to have special containers, and I venture to say that it costs the Government anywhere from 5 to 10 per cent more each year for those supplies by reason of the fact that they are put up in the metric system and the metric system is not uniformly in use in this country by law.

Within the past two or three years in our particular line we find that a great many of the dealers and manufacturers in sundry supplies are using a decimal system. Instead of buying the things by the gross, as we formerly did, or by the dozen, they are now quoted by the hundred. Take such firms as Whitehall, Tatum & Co., of Philadelphia: Their list shows quotations per hundred. Of course, they will sell by the dozen, and it is figured, but that complicates on one end of the line, and it complicates matters for them.

The advantage in the trade is simply this. If a thing is sold per hundred or per ten, it is simply a case of dividing by 10 or 100 instead of by 12 or 144, and it is far simpler. All the rubber manufacturers are coming to it very rapidly, and lots of them are doing it. Take in automobile tires: They are all making their tires now according to the metric system.

So it is only a question of education, and in view of the fact the bill provides that 10 years shall elapse before it shall become effective it seems to me it would not work any hardship.

The CHAIRMAN. Do you think if this bill is not passed, or any other legislation, that gradually through a process of education the system will become one of general use in this country?

Mr. HILTON. I think eventually it is going to, but it is going to take a great deal longer. I do not think there is any question about it. The only objection that I can see——

The CHAIRMAN. The demands of trade and commerce will bring it about?

Mr. HILTON. The demands of trade and commerce are going to bring that about. We are losing that to-day, the farmer is losing it, the manufacturer is losing it, the jobber and the exporter are losing it.

The CHAIRMAN. Where is the farmer losing anything?

Mr. HILTON. The farmer is losing it in this way: He will not stop and spend just a little time to get down to one system, so that his products will be sold by weight, and meeting requirements.

The CHAIRMAN. Will they find a more ready sale and command a larger figure if he will deal in the metric system?

Mr. HILTON. I think so, for this reason: Our foreign trade would largely expand. We found it out during the war. Our drug journals were full of it, imploring manufacturers to seek the trade and put up their products in the metric system. The war is over. We still have some of that foreign trade, but Germany, France, and England will get it—England not as rapidly as Germany and France. Germany is going to acquire it and is going to give them exactly the thing they want, and they only work in metric units. It seems to me it would be a decided step in advance.

The CHAIRMAN. The exporter is the man who sends the surplus produce abroad. He gathers and assembles the produce from the farmers and the ranchers. Does not he use that system? Could he not use that system in the foreign trade?

Mr. HILTON. It might be true that he could, but you must remember another thing: there is another handling. The minute you handle a commodity an extra time there must be an extra per cent of profit, because there is an extra amount of labor.

The CHAIRMAN. Now, I don't know. What is the handling in the great grain elevators through Minnesota, Wisconsin, and the Dakotas?

Mr. HILTON. Those elevators cost money to operate.

The CHAIRMAN. I am not speaking of that. The exporter buys the grain in bulk in carload lots——

Mr. HILTON. Yes.

The CHAIRMAN. For shipment to New York, say, and exported to Germany.

Mr. HILTON. We have been exporting along that line. With a metric-system unit becoming universal in this country it is, the way I see it, by all means going to help everyone, right from the raiser of farm produce up to the final person who handles the goods—the consumer, because you have but one unit.

I took the trouble only two weeks ago Sunday to make a trip to Baltimore with my wife, and called on a friend who is connected in the jobbing trade handling ladies' goods, notions, and things of that kind. This question happened to come up somehow, and this particular gentleman spoke with reference to the advantage of the metric system, of what an advantage it would be to them to eliminate the gross, to eliminate the dozen, and come to the decimal system, the same as with our money. He was not aware that there was anything at all being considered, but yet he spoke about what an advantage it would be to him.

A few years ago my old preceptor at the college here where I received my first degree paid a visit to Russian-Poland, to Odesso. He took the trouble to go around to the retail stores, a number of them, and go in and ask them for a pound of some commodity. He was handed 500 grams. There was not any question. That was 1⅛ pounds and the price was accordingly.

It simply shows that the foreign element that is coming to this country and is in this country is perfectly familiar with the decimal system, as much so as we are with our money system; and I am quite sure that it would be but a short while before the people in this country would become as familiar with the system of decimal weights and measures as with the money system, as soon as they understand that it compares right along the same lines as our money does.

In our United States Pharmacopœia and the National Formulary it was absolutely necessary for us to abandon those three old systems, the avoirdupois, troy, and apothecaries. The Pharmacopœia of 1870 used the Troy system. The Pharmacopœia of 1880 adopted the metric system, and since 1880 the Pharmacopœia has been published with everything in it in the metric system.

The bigger manufacturers in this country in pharmaceutical lines use the metric system in their manufacture. Likewise the National Formulary saw very shortly after that that it was necessary to do the same. Therefore, in its publication of the second edition, they used both systems, giving the equivalents, so as to educate its users up to the metric system. The fifth edition is about to be published, and will probably be out in the next year or year and a half. Like the fourth edition there will be only the one system, and that is the metric system.

When you come down to analytical work, which is necessary to prove the purity of drugs, you have got to use the metric system. You can not use the other systems and do it satisfactorily. This is the reason that in our particular line, our association, which is now in its seventieth year, has done more to elevate the profession of pharmacy, has done more to bring about a higher purity before the time of the food and drugs act than any other organization, and that is the reason our organization so strongly favors the metric system, and why we went on record favoring this bill.

I would also like, Mr. Chairman, to have this [indicating] made part of your record, a recent publication of one of the largest chemical houses in the country, Powers, Weightman & Rosengarten. They put that out at the present time in the metric system.

The CHAIRMAN. That will be filed in the custody of the clerk, so that it may be referred to by the committee.

Mr. HILTON. I do not know that there are any other points that I can bring out with reference to the bill. I certainly hope the subcommittee will consider it carefully, and that it can see its way to make a favorable report, so that we can have the metric system and eliminate this confused situation that we have at the present time.

The CHAIRMAN. Thank you. Your testimony will be very helpful to the committee.

Mr. HILTON. Thank you very much.

STATEMENT OF MR. S. J. MACFARREN, TRACTION ENGINEER.

The CHAIRMAN. Give the reporter your name, address, and occupation.

Mr. MACFARREN. S. J. Macfarren, traction engineer, living in Washington.

The CHAIRMAN. You know we are considering Senate bill 2267, to fix the metric system as the single standard of weights and measures in the United States, the bill offered by Senator Ladd. You may proceed in your own way.

Mr. MACFARREN. In the way of record I would say that I was a partner in the Duquesne Brass Works in Pittsburgh before the Civil War and before I was of age, and that at the conclusion of the Civil War, after my return from the service, I was on the road for the Pittsburgh and successively the Elizabethport Cordage Companies; later engineer of construction of the blast furnace and machine shops of the Iron Mountain Co., of Durango, Mexico; also I have had some years' experience in pipe lines in the gas region of Pittsburgh, and 15 years in the street-railway business, which is my present business so far as I do any—traction engineer.

A generation ago, in the Erie meeting of the American Mechanical Engineers' Society, which I had recently joined, I was called on to oppose the representatives of the Cramp Ship Yard and the Baldwin Locomotive Works on this very question, and I have never changed my opinion about the metric system since. I notice that the Baldwin Locomotive Works is on my side now, after 30 years. I think that is what is the matter with all the opponents of the system—they are 30 years behind the times.

My observation of 60 years in practical business is that the metric system should have been adopted by the United States when Charles Francis Adams wrote his immortal report on it to this Congress in 1821, along with our decimal system of currency, which we would not exchange for any other system on earth for any price. I consider, too, that if there is any argument in favor of our decimal system of currency which does not apply with double force to the standards of weights and measures, I have never found it in my reading or in my experience, or in the debates which I have had on this subject.

I read a paper on this subject before the Metric Association in Baltimore three years ago, where Mr. Halsey, an author who has written works in opposition to the metric system, was present, and on the same night when Secretary Redfield spoke in favor of the metric system. And in that paper I recall that Mayor Reyburn, of Philadelphia, had had his public-service commission in 1911 report on the weights and measures then used in Philadelphia and on their effect. They reported at that time that the practice was almost universal in Philadelphia of selling certain things like rice and beans by the quart measure to the small retail trade, and that about 70 per cent of it was done with the liquid in place of the dry quart. In other words, the man had only to reach his hand 6 inches to the right or left under the counter to pull out a legal quart by which he cheated his customers out of $1 in every $7.

The same committee reported at that time that the bulk of the retail coal trade in Philadelphia was done with the long ton to buy and the short ton to sell, giving the coal dealers in addition to any percentage on their money a legal but unfair and immoral profit on every pound of coal consumed by the small user.

It is axiomatic that uniformity in standards promotes intercourse and promotes commerce and promotes the establishment of manufactures and industry. That applies just as much to the standards of weights and measures as to any other standards. For instance, the farmer is cheated every day when he sells his grain, he is cheated every day when he buys his goods in the store, by the lack of the metric system. The tax which the lack of the metric system is imposing on the public to-day if expressed in figures would surprise the country. It would be a bigger tax than anything they are talking about in the chamber below. Every housekeeper that buys anything for the table, unless she buys it by weight, is cheated to begin with, and if she buys it by weight, such as borax, sulphur, copperas, and a thousand and one things used in household recipes and work, they are bought by the dealer in carload lots or the long ton—the mine only gets paid by the long ton—but when the dealer sells it he is selling on the basis of the short ton, and then he slips in his avoirdupois and two or three other measures and makes two or three other profits, the jobber and retailer do.

The CHAIRMAN. I would think that would be such a profitable field it would great deal of competition.

Mr. MACFARREN. There is plenty of competition in profiteering, is there not, and the profiteer has no better asset in the world than the lack of uniformity in weights and measures. That is what he trades on. The grain broker in Chicago trades on the 23 or 24 different bushels there are in the United States when he trims the farmer. The elevator man does the same; the foreign grain broker does the same.

The CHAIRMAN. Don't you think, Mr. Macfarren, that through a process of education in the schools it would result in the establishment of this system throughout the country, or by the Government leading, or by voluntary effort initiated by large concerns; or do you think it should be established by enforcement through some statute within some specified time—3 years, 5 years, or 10 years, whatever may be the time provided by law?

Mr. MACFARREN. It is undoubtedly the function and the duty of the Government to regulate weights and measures, and this Government has sadly neglected its duty in that regard, and it certainly should take the lead. My only criticism of the bill is that the Government does not undertake within a year or two or three, or much less time than 10, to do all its business in the metric system, and force the contractors who wish to do business with it that much.

As far as this limit of 10 years is concerned, the only objection I have is that it is too long. Germany took two years, and we are just as smart as the Germans.

The CHAIRMAN. What time would you suggest for the period of transition?

Mr. MACFARREN. I should say five years would be the maximum. Immediately upon such a bill's passage, or even on the passage of this bill, educational arrangements will be made to see that the next generation will be ready for it. And the saving will be effected for all future generations once and for all.

The CHAIRMAN. Do you think it would require a great effort or consume considerable time for the average individual to become familiar with this system?

Mr. MACFARREN. Not sufficient for daily use. An hour's time is plenty for daily use. Of course, if a man wants to go into the scientific side of it, commit to memory all the Greek and Latin names of the units, it might take him a little longer. But for daily use he has no need to commit to memory anything more than the meter, liter, and gram; the world pound, the world yard, and the world quart. That is all there is to it. One hundred liters, a hectoliter, is equivalent to nearly three of our bushels. How long would it take a farmer to get that? How long would it take a woman in a dry goods store to find out the difference between her goods measured by the meter and measured by the yard, which would mean that she would get 10 per cent more than when she bought by the yard? It would not take her 10 minutes.

The CHAIRMAN. I am interested in that. What effort would be required to employ this method, and how extensive a knowledge would you have to have of this system? Do you think it could be done within 30 minutes?

Mr. MACFARREN. Yes, sir; by the ordinary person.

The CHAIRMAN. How much knowledge would they have to have?

Mr. MACFARREN. They would have to know that a meter is 10 per cent longer than a yard, that a liter varies but little from the liquid quart, although it varies very largely from our dry quart; that five hundred grams is two and one-tenth pounds; in other words, half a kilogram. That is 10 per cent more than our pound. You could use the fraction half as well as with the decimal system. A meter is a yard and one tenth; a liter is 61.02 cubic inches, while our liquid quart is 57.75 and our dry quart is 67.02. How long would it take a man to learn that? If I was a farmer, and I was hiring a man to haul manure to the orchard, I would not keep him if he could not learn it in an afternoon. I would tell him that he did not have intelligence enough to handle those oxen.

I would like to say that I have observed that the people who oppose the metric system are like the old man in the story who said he had had a heap of trouble, the most of which never happened. People said that it would cost the Crane Co., with its 8,000 men in the shops, hundreds of thousands of dollars to adopt the metric system. They were familiar with the fact that the Packard Automobile Co. paid McCarty $50,000 for reorganizing their shops on the efficiency system. It did not cost the Crane Co. anything except possibly 5 per cent on their next year's printing bill. That is all it cost them; and they are testifying to that every minute to this day.

Where would the United States have been in the war if France had not had the metric system? How many millions of dollars would we have saved if we

had had the metric system to use in making shells, instead of having to educate the men? How long did it take us to educate the machinists to make shells, which won the war, for the French 75's? It did not take one week in any shop.

My residence in Mexico showed me that the metric system not only promotes domestic commerce and makes domestic commerce in daily business and living, but it promotes export trade, because it simplifies the transaction between buyer and seller, and takes some of the power away from the intermediate broker. Now he has both sides at his mercy by reason of his better knowledge of these little details. But when the two parties can come in with the same system of weights and measures—for instance the man doing a mail-order business here. I have a friend doing a mail-order business in slide rules for calculating. When he is dealing with his customers abroad in the metric system he has no complications at all. They know what a millimeter is as well as he does. It is of tremendous advantage.

It is only a year or two since an invoice of goods was confiscated at a port in Peru, and it took the good offices of the State Department to release it, because the invoice was not in metric terms. That was the action of our South American friends, who are the best customers we can hope to have. I have no faith in China and Japan trade. The countries to the south of us are our neighbors. When we handle Argentina and the other South American countries as we have handled Mexico, we can not put enough people on our continent to make the goods they will require of us. There is no end to the trade. But we have to do it their way. The Germans have been doing it their way for 25 years, and they got what they wanted.

We have had over and over again to take a leaf out of other's books in the effort to get foreign trade, and we need to take that leaf out of the German book quickly before they get it all away from us again. By an accident we had a big export trade, but we are losing it by natural causes, one of which is the metric system, and we will continue to lose it by those natural causes if we do not adopt the metric system. There is nothing but a common language that will tend so much to bring two distant nations together in the bonds of friendly commerce as uniformity of weights and measures.

If there was some other system that competed with the metric system in scientific convenience, there would be some question about it. Take the single matter, to mention a scientific illustration, of the specific gravity of substances. In our engineering books there is a formula set out: Subtract the weight of a thing in water from the weight in air and divide it, etc., etc. It is a thing that a man does not recollect and has to refer to a book. When he gets it, it takes minutes to do it. But in the metric system the weight of a thing in grams is its specific gravity. That is all there is to it. Weigh it on a metric scale and write it in grams. That is its specific gravity. That thing alone in many chemical and scientific works would save large amounts in clerk hire, large amounts of time and actual labor, to say nothing about strain. You would save converting of one set of units into another. In the metric system it is like our decimal system. Move your decimal point, and you have divided by ten or a hundred, as the case may be.

But take our present system. How complicated are vulgar fractions. How many useless headaches are being inflicted on willing children now with vulgar fractions as applied to every-day business, the buying of household supplies, buying and selling farm products, recipe for a sick animal, or an emergency recipe for a sick person. Here is our very coinage system, which is metric now. You can rig a temporary balance and weigh out the quantities desired, rig it in two minutes, without going 10 miles to a drug store from some prairie farm.

There is nothing to be said for our system of weights and measures in comparison with the metric system, any more than you can compare the British system of currency with ours. Anybody who has had to calculate the interest on less than $100 expressed in pounds, shillings, and pence of the British system would not be found dead with it if he could get our decimal system. It is just the same here. Anybody that really knows and appreciates the metric system would not be found dead with our present system of weights and measures.

I thank you very much for your kind and courteous treatment, Senator.

The CHAIRMAN. Very well; thank you for your presence and testimony. That is all for to-day, and we will adjourn until to-morrow morning at 11 o'clock.

(Whereupon, at 11.50 o'clock a. m. the subcommittee adjourned until to-morrow, Wednesday, October 26, 1921, at 11 o'clock a. m.)

THE METRIC SYSTEM.

WEDNESDAY, OCTOBER 26, 1921.

UNITED STATES SENATE,
SUBCOMMITTEE OF THE COMMITTEE ON MANUFACTURES,
Washington, D. C.

The subcommittee met, pursuant to the adjournment of yesterday, at 11 o'clock a. m., Senator Charles L. McNary presiding.

STATEMENT OF MR. JOHN S. HORD, FORMER COLLECTOR OF INTERNAL REVENUE, PHILIPPINE ISLANDS.

The CHAIRMAN. State your full name to the reporter, with your residence and occupation.

Mr. HORD. John S. Hord, Washington, D. C. For several years I was collector of internal revenue in Manila.

The CHAIRMAN. Have you read the bill we are considering—S. 2267?

Mr. HORD. Yes, sir.

The CHAIRMAN. I would like to have you discuss the subject as you desire and in a way that, when placed in the record, will be useful to the subcommittee.

Mr. HORD. My experience with the metric system was in the Philippines during the years 1906 to 1910. There was a law enacted by the Philippine Commission in August, 1906, making the use of metric weights and measures obligatory in the islands. At that time I was collector of internal revenue for the islands, and the enforcement of the law was placed in the internal revenue bureau.

We had some difficulty at the start getting the necessary standards. We had to get some from Paris and a good many of them from this country. But at the end of 1908 we had them installed in the eight hundred and odd towns in the Philippines. At that time there were about 8,000,000 people there, some of them quite ignorant; but within a couple of years after beginning the installation of the system it was in general use, and has continued so up to three years ago, when I left the islands to come here to Washington—that is, for a period of 10 years, to my knowledge, it worked satisfactorily.

At the time we put in the metric system there were in use there a large number of crude Filipino systems, such as the "ganta," "caban," "chupa," besides the Spanish "arroba" and all kinds of English and French methods. The French metric system had gained some headway in the islands at that time. It was known to some of the better merchants in Manila and in some of the larger towns. But the other measures I have mentioned were in general use throughout the Islands, and the main object in putting in the metric system at the start was to avoid the opportunities which these complicated systems gave for fraud on the purchasers of goods. We studied the situation out there some before writing the law, and then we amended it to fit the situation. The law is here if you want to examine it.

The CHAIRMAN. The system was enforced upon the people there through enactment of a statute?

Mr. HORD. Yes, sir.

The CHAIRMAN. In what year was it passed?

Mr. HORD. August 3, 1906. There are a number of laws in this compilation. Our bureau had the enforcement of the pure food laws, opium laws, the standardizing of money out there, putting in the 50-cent dollar, the peso, and other

similar laws. The act is numbered [illegible] entitled "An act to provide for inspecting and sealing weights and measures."

The CHAIRMAN. What was the period of transition allowed by the statute?

Mr. HORD. About seven months. The law was enacted August 3, 1906, and took effect January 1, 1907.

The CHAIRMAN. Was there any complaint against its enforcement or was it generally accepted in the seven months?

Mr. HORD. None whatever. The only delay, as I stated, was caused by our failure to get the standards quick enough.

The CHAIRMAN. Can you say, in a brief statement, how the present proposed legislation, Senate bill [illegible], differs, if at all, from the Philippine law?

Mr. HORD. I read this over once. Of course, it is shorter than our law. It does not go into as many details. It does not mention the specific standards, but the metric system is absolutely the same the world over, so I presume that would have no effect on it. We gave more detail in our law, as you will see.

We provided for a set of standards to be placed in the municipal treasurer's office in every one of eight hundred-odd towns in the islands. Then we had a traveling force of American agents who, besides internal-revenue work, opium work, and other work, saw to the standardizing of all weights and measures in every store in every town in the islands. They were supposed to correct those weights and measures which were incorrect and to destroy others which could not be corrected—destroy them on the premises. The man owning the incorrect weights and measures was put under bond and warned if he again used them or used other incorrect weights and measures he was to be severely punished by fine and imprisonment. But there was very little attempt to defraud the law. They looked on it as a time saver instead of a hardship. We had other laws to enforce, such as prohibiting the use of opium and enforcing internal-revenue taxes on about everything that was made and sold, and there was a great deal of opposition to those laws, but I can remember now practically none to this law. Its operation was so simple that, as I stated a while ago, they did not look on it as a hardship. It was so much simpler than any of the other methods they had had. They had a Chinese tape line with a knot tied in it for measurement, I remember, which was rather flexible. So the opportunities for fraud were illimitable under the old system. They had buying and selling scales which would weigh different—things of that kind.

We charged a fee of a few cents for sealing. For comparing the measure the merchant had with the standard in the municipal treasurers' office we charged a fee for that service, the issuing of a certificate, and marking, which was a stenciling of some of the measures—the iron or metal ones.

As I say, I have been away from there over three years. I came here in 1917 to do war work. But I have heard nothing to indicate that this system has been abandoned. However, Mr. Gabaldon, who has an office in the House Office Building, who is the Philippine representative here, a Delegate in Congress, could give you the information right up to date as to the present status of the situation there.

The CHAIRMAN. Was the system taught in the public schools prior to the adoption of the law?

Mr. HORD. France installed the system. I think it was about 60 years ago.

The CHAIRMAN. In the Philippines?

Mr. HORD. I was going to say that the system taught in the public schools there under Spain was the Spanish system. The merchants there were largely Chinese, some French, and some German. When France introduced the metric system, then they began to use it in the Philippines. But it was not in general use. I could not say what was taught in the schools.

The CHAIRMAN. What system did the masses of the people use?

Mr. HORD. All of these systems, these Chinese tape lines, the Spanish arroba, the Philippine ganta and cavan—there were dozens of them.

The CHAIRMAN. I can see the necessity in the islands, with all these different methods, of having a standard system. But, of course, the same condition does not obtain in this country. We have one system.

Mr. HORD. Well, we have the English system, which was our system there, of yards, pounds, ounces, and so on; but we found that the metric system out there was far superior to the English or any other system in use there as our dollars and cents are superior to the pounds, shilling, and pence, for instance.

In bookkeeping—in fact we kept the accounts of the bureau largely in the metric system, because it was simpler to do it; it involved much less work.

The CHAIRMAN. Do you think of anything further you desire to say with respect to this proposed legislation?

Mr. HORD. I have read this bill, and, of course, I have a fairly good knowledge of conditions in the United States, but I could not say whether this bill will fit local conditions in this country to the extent that our bill fitted local conditions in the Philippines. It seems to me to do so.

The CHAIRMAN. This bill provides, as you know, that the law shall become effective 10 years from the passage of the act.

Mr. HORD. Yes. We gave seven months out there, and notwithstanding the large number of other weights and measures it fitted right in; there was no objection. The time was not too short.

There are regulations here in the appendix of this publication for the enforcement of it. I do not know whether you want to see those or not.

The CHAIRMAN. For the use of the committee we can get this statute.

Mr. HORD. This is a manual of all the laws. I doubt whether you have this here. You would have the statute, because the Bureau of Insular Affairs would have all the laws.

The CHAIRMAN. I think the Library of Congress has a copy of every published volume in the United States and its Territorial possessions.

Mr. HORD. It may be. This was gotten out for the official use of the bureau. In that case it was printed in Manila. It was published in 1908.

The CHAIRMAN. What is the title of it?

Mr. HORD. Internal Revenue Manual of Philippine Laws, published in 1908. In appendix TT, page 538, is a complete list of the regulations for the enforcement of the law. These (indicating) are the first two annual reports made after the law went into effect. These you can find in the Bureau of Insular Affairs, and they have also, if you want to go into more complete detail, a very complete record there of the hearings out there held by the Philippine commission.

Will that be all?

The CHAIRMAN. Yes. I thank you very much. The committee will make good use of the information which you have given it.

STATEMENT OF ADMIRAL R. E. COONTZ, UNITED STATES NAVY, CHIEF BUREAU OF NAVAL OPERATIONS, NAVY DEPARTMENT.

The CHAIRMAN. Admiral, will ou please state, for the record, your full name and title?

Admiral COONTZ. R. E. Coontz, Admiral, United States Navy; Chief, Bureau of Naval Operations, Navy Department.

The CHAIRMAN. We are discussing, as you know, Senate bill 2267, having to do with the establishment of the metric system as the single standard of weights and measures for the United States. I know that a statement from you will be helpful to the committee, and as we will read the record in passing finally on the merits of this measure, I should like to have you place such matter in the record as you think would be useful to us, both in the way of a verbal statement and data which you may have in your possession.

Admiral COONTZ. Mr. Chairman, I would state that the Navy Department is composed of a number of bureaus and subdivisions, including Navigation, the Hydrographic Office, the Bureau of Ordnance, the Bureau of Engineering, the Bureau of Aeronautics, the Bureau of Construction and Repair, the Bureau of Medicine and Surgery, the Bureau of Supplies and Accounts, the Bureau of Yards and Docks, the Office of the Judge Advocate General, and the Office of the Major General Commandant.

The Secretary of the Navy, when the committee brought this matter up, had the bill in question referred to each bureau for comment, with the understanding that later it was to be taken up in the Secretary's council and a departmental opinion evolved.

These reports came in. I have the recommendations of the various bureaus here in short order and am prepared to place in the record the full views of each chief of bureau. I also have here the decision of the Navy Department in the matter in a few short words, if you care to hear it.

The CHAIRMAN. In writing, you say?

Admiral COONTZ. I have the short views here. I am prepared to put in the record the letters of the chiefs of bureaus more at length, going into the technical discussion of the matter.

After careful consideration and condensing the views, the Secretary of the Navy decided that the department's view was as shown at the bottom of this sheet, under the heading, "View of the Navy Department."

The CHAIRMAN. Yes; this will be very interesting to have in the record.

(The paper referred to is here printed in full, as follows:)

Memorandum regarding the metric system bill.

Bureau or office.	Brief of views.
A. Navigation	Impracticable at this stage of country's development. The system would be out of harmony with that used by the remainder of the English-speaking world, viz., the part that conducts the larger part of the world's business.
B. Hydrographic Office	Advances adverse reasons, terminating with: "The only nations using the metric system have an inconsiderable merchant marine and were the United States to adopt this system now it would be joining the minority and would actually make its books and charts less available for general use than they are at present. If it is eventually decided to use this system, the Hydrographic Office should not be committed to its adoption prior to the adoption of this system by Great Britain. A simultaneous adoption of the system by the two countries would greatly reduce the inevitable confusion resulting for a time from the new system and would make British and American charts and publications the most comprehensive collection in the world, available to the mariners of both nations at all times."
C. Ordnance	If the present system is to be changed at the end of 10 years, it will result in an enormous expense to the government, and, pending the change, would result in considerable confusion.
D. Engineering	From all general considerations, the bureau is not in favor of the bill.
E. Aeronautics	The adoption of the metric system would be detrimental to the interests of the Navy Department.
F. Construction and Repair	Against the bill for excellent technical reasons given in full in inclosure F.
G. Medicine and Surgery	This bureau is unquivocally in favor of Senate bill 2267. The reasons advanced are, however, concerned only with the use of the metric system in the sciences, and more particularly, in the practice of medicine.
H. Supplies and Accounts	In principle favors the system. The bureau is not informed as to whether or not it is practicable to adopt the system for use in this country until an indefinite date in the future.
I. Yards and Docks	Chief of bureau is heartily in favor of the adoption of the metric system, etc.: "The chief of the Bureau of Yards and Docks is heartily in favor of the adoption of the metric system, but believes this bill is too drastic, by prohibiting the use of any other system beginning 20 years after the passage of the act, as there is a large amount of property in the country that has been constructed in accordance with other systems of measurement, which will require repairs and replacements for many years to come, and it is believed that an exception should be made for repairs and replacements of articles purchased or constructed prior to the date that this act goes into effect."
J. Judge Advocate General	Comments on legal phases of the bill only. The bill has no enforcement provision.
K. Major General Commandant.	The change to the metric system would be very difficult and very expensive as far as material is concerned, but from a purely military standpoint it would be advisable.
The department's stand	While academic reasons might under normal conditions justify this change, which would be far-reaching in its effect upon the material used by the Navy, the condition of the business of the country makes the present time inopportune for pressing the passage of the bill. Furthermore, before this country finally decides to adopt the metric system, the other English-speaking nations of the world should be approached in an effort to secure joint and simultaneous action. Without such joint and simultaneous action this country would be placed at a great commercial disadvantage. The opportune time for the passage of such a bill would be when the country is in the full flush of a period of great commercial prosperity, when the burden of expense incident to the change would not be so deadening in its effect upon business. The expense to the Navy Department, of adopting the metric system would be very great, even if spread over a 10-year period. The Navy Department is, therefore, against the passage of this bill unless and until the other English-speaking nations of the world will also adopt the metric system, and the department believed that the present is not a good time to consider the matter.

Inclosures: A. Views of Navigation. B. Views of Hydrographic Office. C. Views of Ordnance. D. Views of Engineering. E. Views of Aeronautics. F. Views of Construction and Repair. G. Views of Medicine and Surgery. H. Views of Supplies and Accounts. I. Views of Yards and Docks. J. Views of Judge Advocate General. K. Views of Major General Commandant.

Admiral COONTZ. Each bureau has given its views and opinions at length. The Hydrographic Office refers to the question of charts over the world. The Bureau of Construction and Repair tells of its effect on the shipbuilding indus-

tries of the country. There are two or three of the bureaus which favor it, notably Medicine and Surgery, which uses it, and Supplies and Accounts. But the overwhelming concensus is as shown in the paper here, that represents the views of the Navy Department at the present time, in view of the economic situation which must be taken into consideration; the great cost that would accrue in case we adopted it, as far as the naval service is concerned; and therefore it presents that view to the committee.

I do not know that I care to go into it any deeper, because by placing copies in the hearings it can go into any question brought up there.

The CHAIRMAN. Then, in a word, Admiral, the Navy Establishment is opposed to the passage of the pending bill?

Admiral COONTZ. At the present time; yes, sir.

The CHAIRMAN. Can you state in a word the reasons, or are they all set forth here?

Admiral COONTZ. They are right there. I think they are summed up in the last sentence.

The CHAIRMAN. I will read the last sentence here in this memorandum:

"The Navy Department is, therefore, against the passage of this bill unless and until the other English-speaking nations of the world will also adopt the metric system; and the department believes that the present is not a good time to consider the matter."

Admiral COONTZ. Yes, sir.

The CHAIRMAN. That is the judgment of the Navy Department?

Admiral COONTZ. Yes, sir; that is the judgment of the Navy Department. If it is desired, I will be very glad to furnish copies of the complete views of these bureaus, some of them four and five pages in length.

The CHAIRMAN. We would be delighted to have them. Have you that record with you now?

Admiral COONTZ. I have the originals, but I would prefer to furnish you with copies. I can send them down when I return my statement, which I presume will be sent to me for revision.

(The papers referred to by Admiral Coontz are printed in full, as follows:)

NAVY DEPARTMENT,
BUREAU OF NAVIGATION,
Washington, October 7, 1921.

From: Bureau of Navigation.
To: Chief of Naval Operations.
Subject: Hearings on S. 2267—Data for department's opinion on S. 2267.
Reference: Chief of Naval Operations letter 26256–512, Op–24 EE 10/6 of October 6, 1921.

1. The proposed change to the metric system is not recommended, as it is believed to be impracticable at this stage of the country's development. The system of weights, measures, and areas now in use in this country is that commonly used by the English speaking world and that most generally used in carrying on the world's commerce.

2. The present system is the only one with which the great majority of the people are familiar. They think in terms of miles, acres, rods, yards, feet, and inches; tons, pounds, and ounces; bushels, pecks, gallons, quarts, pints; cords and barrels, and on these standard units the commerce of the country is conducted, and they are those upon which standard parts of all mechanisms, from screw threads to heavy machine parts are based. To make this change would not only create great confusion and annoyance to the public generally, but would necessitate reinventories and repricing of all commodities, based upon the proposed new units with the resulting scrapping of all scales and measures now in use, and the republishing of all price and stock lists, scales of distances, as shown on maps, plans and drawings, areas of farms and city lots in all county and State offices of record, and at incalculable cost to industry and commerce, as well as national, State, county, and municipal governments, and involving vast computations, besides wiping out the vast trade that has been laboriously built up based on standard parts of all types of mechanism and structural material.

3. We would then have adopted a system that would be out of harmony with that used by the remainder of the English speaking world, viz., the part that conducts the larger part of the world's commerce.

4. As the proposed system does not affect angular measurements there would be no advantage to most mathematical computations or to astronomy or navigation by its adoption.

5. It is believed that greater confusion could only be produced by an attempt to change the language of the country.

PHILIP WILLIAMS.

HYDROGRAPHIC OFFICE,
Washington, October 7, 1921.

To: Chief of Naval Operations.
Subject: Adoption of the metric system, with particular reference to its effect on the Hydrographic Office.

1. The question of adopting the metric system has been considered many times in the past by the Hydrographic Office, and the following may be considered a summary of its opinion on this subject:

(*a*) The metric system is unnecessary to the office either in its production of books or charts, as the present system is accurate and flexible and entirely adequate to all demands made upon it.

(*b*) The metric system can not be applied universally in hydrographic work, because measures of time and angles are not provided for in this system.

(*c*) There is no question of the desirability of a universal system of measurements for the mariner. This is almost accomplished at present by the British system, whose units are used by British and American shipping and are understood by most mariners. It will be much easier to educate the mariners now using the metric system into using the British system than conversely.

(*d*) The seafarers are a peculiar class and conservative to a degree and it will be extremely difficult to accustom them to a new system of measurement. Ten years is entirely too short a time for this work, and if this system should ever be adopted it would be absolutely necessary for the law to provide that the system should not go into effect at sea until in the opinion of the Secretary of the Navy the American maritime community was prepared for the change.

(*e*) To change the present charts from fathoms to meters would in many cases require new surveys, for the fathoms and fathom curves indicated on the chart only represent an approximation to the depths shown on the chart. It would be quite impossible in many cases to change this approximation into an approximation of meters without introducing additional errors. It would be quite impossible to estimate the time and money necessary to change the hydrographic charts and publications from the British to the metric system.

(*f*) The only nations using the metric system have an inconsiderable merchant marine and were the United States to adopt this system now it would be joining the minority and would actually make its books and charts less available for general use than they are at present. If it is eventually decided to use this system the Hydrographic Office should not be committed to its adoption prior to the adoption of this system by Great Britain. A simultaneous adoption of the system by the two countries would greatly reduce the inevitable confusion resulting for a time from the new system and would make British and American charts and publications (the most comprehensive collection in the world) available to the mariners of both nations at all times.

L. R. DE STEIGUER.

NAVY DEPARTMENT,
BUREAU OF ORDNANCE,
Washington, D. C., October 7, 1921.

To: Chief of Naval Operations.
Subject: Hearings on bill S. 2267.
Reference: (*a*) C. N. O. letter 26256–512 of October 6, 1921.

1. The bureau is of the opinion that Senate bill 2267, tending to force the use of the metric system upon all people in the United States, should receive the attention of all interested parties prior to its passage.

2. So far as this bureau is concerned, practically all of its measurements have been given in inches and decimals thereof—practically none being used in the metric system. If this system is to be changed at the end of 10 years, it will result in an enormous expense to the Government, and pending the change, would result in considerable confusion.

3. The bureau designates Commander H. F. Leary, United States Navy, as its representative in this matter.

CHAS. B. MCVAY, Jr.,
Chief of Bureau.

OCTOBER, 1921.

From: Bureau of Engineering.
To: Chief of Naval Operations.
Subject: Recommendations of the Bureau of Engineering relative to bill now pending in Congress to make the metric system the sole legal system of weights, measurements, etc., in the United States.

1. Theoretically the metric system is ideal in ease of calculation. The system is in use in many countries in which we are reaching out for foreign trade, and this fact would make it advantageous to adopt the system from the standpoint of the limited interests that are engaged in foreign trade. At present, manufacturers producing for both foreign and domestic trade are required to have two sets of gauges and measuring units. Accurate working in the shops is just as easy under the present system as it would be under the metric system. From a designing standpoint the use of the metric system would be easier than the use of the present system. The present system in the United States has been in use for approximately 150 years, is thoroughly understood, and is practically universal, changing to the metric system would subject the country to a tremendous expense in changing gauges, drawings, schedules, etc., and for general domestic purposes the advantages would not be very great.

2. The screw-thread system now in use in this country is an adaptation of the old A. S. M. E., U. S., and A. A. E. A. standards, and has been standardized on the ratio of pitch, diameter, etc., there being four fits specified, loose, medium, close, and wrench; this is not based on the metric system, although it can be expressed in the metric units of measurement.

3. From all general considerations the bureau is not in favor of the bill.

4. The bureau desires its representative to be present at the hearings.

J. K. ROBISON,
Chief of Bureau.

OCTOBER 8, 1921.

From: Chief of Bureau of Aeronautics.
To: Chief of Naval operations.
Subject: Hearings on S. 2267—Data for department's opinion on S. 2267.
Reference: (*a*) Chief of Naval Operations letter of October 6, 1921, No. 26256-512: Op-24 EE 10/6.

1. As far as the wording of the Ladd bill, inclosed with reference (*a*), is concerned, it appears to satisfactorily accomplish its designed purpose. As far as the principle is concerned, this bureau is not convinced of the desirability of making the metric system mandatory. For certain purposes it is useful and is already in use in the United States to such an extent that its use in conjunction with the foot-pound-second system causes no extraordinary confusion. Several discussions have been held at which the older bureaus of the Navy Department, notably Engineering and Construction and Repair, have taken part. The position taken then is still considered sound, namely, that the adoption of the metric system would be detrimental to the interests of the Navy Department. There is something peculiar to aircraft work or the aircraft industry that warrants its special consideration.

2. This bureau does not desire to have a representative present at the hearings on the Ladd bill, but will be glad to furnish on request any additional information in support of the position above outlined.

W. A. MOFFETT.

NAVY DEPARTMENT,
BUREAU OF CONSTRUCTION AND REPAIR,
Washington, D. C., October 8, 1921.

To: Chief of Naval Operations.
Subject: Hearings on S. 2267—Data for department's opinion.
Reference: (*a*) Chief of Naval Operations letter of October 6, 1921, No. 26256-512 Op-24 EE.

1. The proposed legislation referred to, introduced in the United States Senate July 18, 1921, provides in effect as follows:

"That from and after 10 years from the date of passage and approval of this act, the weights and measures of the meter-liter-gram, or metric system, shall be a single standard of weights and measures in the United States of America for the uses set out herein."

2. The provisions of the bill are to some extent indefinite in that several of the metric units have been practically nowhere adopted for use, notably the metric units of angular measurements, time, and nautical distances. Assuming, however, that it is the intention of the proposed law to cover only the commonly employed units of length (with the derived units of area and volume), mass and temperature, the arguments against its adoption are the enormous cost and difficulty of the transition, the practical impossibility of universal enforcement, and the very slight advantage, if any exists, from the manufacturers' and engineers' standpoint in the use of the metric system.

3. The protagonists of the metric system are principally scientists or others whose use of any system is confined to measuring things after they are produced and they have little conception of the builders' or manufacturers' use of weights and measures which consists in making things to specific sizes. Even in countries where the metric system has been in use for a hundred or more years, the manufacturing standards are by no means universally in this system.

4. The present units are inseparably connected to the history, the literature, and the standards of manufacture, particularly of shipbuilding and to the mental concepts of dimensions acquired gradually through life and familiar to all in the shipyard or factory, from the unskilled laborer to the trained engineer, which are fundamental in carrying out work with facility. To change all present standard sizes of manufactured articles or material to conform to metric standards, with the consequent manufacture of new patterns, rolls, jigs, templates, dies, etc., would involve prohibitive cost, and to express the present standard sizes in metric units—which, of course, would not result in exact or simple figures—would involve an equally prohibitive confusion in dimensions and in mental conception of sizes.

5. The impossibility of this change is recognized in the proposed law itself in section 8, clause 2, which provides:

"That nothing in this act shall be understood or construed as applying to * * * the construction or use in the arts, manufacture, or industry of any specification or drawing, tool, machine, or other appliance or implement, designed, constructed, or graduated in any desired system."

6. This in itself would preclude a universal adoption and use in this country of the metric system without the added reasons of the necessary changes in mental concept of dimensions and the natural demand of everyone for a binary system of subdivision in the ordinary dealings of every-day life.

7. The arguments in favor of the metric system have centered about the dimensional, mass, and temperature units, to the neglect of units of time and angular measure. From a logical and metric point of view the latter are equally important. Astronomers and scientists, however, are still using the sexagesimal division of the degree and hour into minutes and seconds, notwithstanding the fact that tables for computing in "grades" and centesimal divisions are in existence, for the sufficient reason that their historic records are written in the sexagesimal division and to change would involve enormous labor, entirely disproportionate to its utilitarian value. Similarly, speeds of seagoing ships are given in knots or nautical miles per hour, even when the dimensions of the ships themselves are given in metric units. The above reason for maintaining the established system of sexagesimal division of the degree and hour does not apply so rigidly to the dimensional, mass, or temperature units in the greater portion of scientific work, because previous to the adoption of the metric system there was no uniformity in scientific literature as to these units.

8. In engineering construction and manufacturing, however, a similar reason exists, particularly in the shipbuilding industry.

9. The art of naval architecture is to a very large extent an empirical one, the success of the design depending largely upon the successful comparison of previously obtained data and results. Therefore the comparative value of different units is an essential part of the work of design, and the judgment of the naval architect, draftsman, designer, business man, purchasing agent, or workman in the new units would be of no value whatever.

10. The valuable files of plans or ships of present and past navies would at once become almost valueless as drawings of precision, as their dimensions would in every case have to be converted, mentally or otherwise, into the new system.

11. A change to the metric system in this country would immediately cut us loose from the past, present, and probable future literature and practice of

Great Britain as well as from our own records and previous practice, compared to which the literature and practice of nations using the metric system is a very minor matter.

12. The real reasons for the adoption of metric units where they have been successfully introduced are not logical and theoretical reasons, but practical ones derived from the necessity of uniformity and certainty in use.

13. The practical arguments advanced as to the ultimate advantages of the metric system, to obtain which we are obliged to go through a "transitional period," with its confusion and enormous cost, are the supposed simplicity and adaptability of the metric measures and the added ease in making calculations.

14. As to the first, in shipbuilding work where the metric system is used there is a constant change in stated dimensions between the millimeter and the centimeter that is apt to be confusing. The units are either too small or too large and the convenience of binary subdivision is lacking. There is alleged against the English system the large number of subsidiary units. A shipbuilder or the ordinary manufacturer has no use in his business for apothecary's weight, troy pound, etc. Those measures are used by people in special occupations, who use them because they are convenient for their work and because they are tied to past history. They do not in any way affect the shipbuilder, for his standards of length and weight are well established and uniform and there is no uncertainty about them.

15. In regard to the adaptability of the metric units with their decimal subdivision to calculations the greater number of arguments have been advanced. The practical identity between the kilogram and the weight of a cubic decimeter of distilled water is one of the major advantages claimed in favor of the metric system. This is no assistance to the shipbuilder, whose principal calculations involve quantities of salt water, liquid fuels, and other liquids, and very little, if any, use of water of standard density. The undoubted advantages of the use of decimal subdivisions can be and are met by the use of decimal subdivisions of our present units, and when it becomes necessary to transform results of calculations into larger or smaller units the added labor of the processes, which in the present days of calculating instruments is very slight, is much more than offset by the very real advantage of a complete change in the figures, as it facilitates detection of large errors by inspection. In a purely decimal system the change in unit is solely dependent on the location of the decimal point, which is a prolific source of error.

16. For the foregoing reasons, which might be developed at great length, the bureau considers that the passage of the bill in question would be highly detrimental to the shipbuilding industries of the country.

TAYLOR.

DEPARTMENT OF THE NAVY,
BUREAU OF MEDICINE AND SURGERY,
Washington, D. C., October 8, 1921.

To: Chief of Naval Operations.
Subject: Metric system; hearings on Senate bill 2267; data for department.
Reference: Your circular letter to chiefs of bureaus, No. 26256–512, October 6, 1921.

1. This bureau is unequivocally in favor of Senate bill No. 2267—a bill to fix the metric system of weights and measures as the single standard of weights and measures for certain uses.

2. As long ago as 1878 the Secretary of the Navy approved an order providing that "the metric system of weights and measures shall hereafter be employed in the Medical Department of the Navy." Our supply table for the Medical Department, United States Navy, is based upon this system, and embarrassments have been constantly encountered owing to the fact that the units as supplied by commercial firms to the trade were based upon other systems.

3. In the exact sciences the conveniences of the metric system have resulted in its universal adoption. In this respect it is already an international system, and the worker who attempts the use of other older and more cumbersome systems finds himself in difficulties. The activities of the modern medical man and the pharmacist are so intimately associated with the exact sciences that they must of necessity learn the metric system of weighs and measures. Moreover, the United States Pharmacopeia has practically used no other system for the past four decades.

4. The older practitioners of medicine as a rule have not familiarized themselves with the metric system, but the number of those who do use it is con-

stantly on the increase despite the fact that it is not compulsory. An investigation just prior to 1900 showed that of more than 1,000,000 prescriptions filled in the United States already an average of 6 per cent were written according to this system, the percentage varying by States from 0.5 to 20 per cent. The net result, however, is that during this transition period both the medical man and the pharmacist are burdened with the old and the new—the superfluous and the useful, and not only is the mental labor increased, but duplicate equipment must be supplied to accommodate all, or one is driven to the necessity of constant translation from the terms of the one system to the other.

5. The metric system is on a decimal basis and has the advantages of inherent simplicity, brevity, and adaptability to everyday needs. Every weight and measure bears a simple relation to the initial unit, the meter. Various denominations are obtained by multiplying or dividing any unit by the same number (i. e., 10), and thus an increase or a decrease is expressed by simply moving the decimal point.

6. By its adoption we (*a*) eliminate the confusion attendant upon the present use of antiquated and cumbersome systems, i. e., apothecaries (or troy) and avoirdupois, and wet and dry measure, whose pounds, ounces, gallons, etc., vary not only between the systems but also between countries; (*b*) efficiency is increased through the saving in time and mental labor in calculations; and (*c*) saving is effected in equipment now duplicated to permit use of all systems.

7. The advantages of the metric system will eventually cause it to be universally adopted, and the main objections at the present time are the cost of transition in commercial fields and the lack of a general familiarity with the new system. The reasons given under paragraph 6 would ultimately more than counterbalance initial financial loss. Dealers in scientific supplies have managed to survive the change. The legally mandatory metric system would soon stimulate education. We legally and successfully abolished a complex system of coinage more than a century ago, and now find our decimal system of dollars and cents entirely satisfactory, although there was considerable dissatisfaction during the period of change. Why not apply the same principle to our system of weights and measures?

8. The metric system is already an international system, even otherwise than as an instrument of the exact sciences. Its use has been legalized in practically every civilized country and is compulsory in many. It is already slowly but surely displacing all other systems.

9. The advantages of a simple and uniform international system of weights and measures, from the standpoint of commerce, are obvious, and equally so the difficulties that a foreign visitor may encounter in this connection. This applies to medical men, and particularly to those of the Navy, who are often forced to secure supplies that are dispensed in strange units; the drachms and minims of their prescriptions are unintelligible to the dispenser; and even if the latter deals in quarts, gallons, etc., the values of these may be entirely different from ours.

10. And, finally, the use of more than one system for writing prescriptions is dangerous. Not infrequently there will be a misinterpretation on the part of the pharmacist that is not to the best interests of the patients. A prescription in the metric system tends naturally to greater legibility in that the decimal point is indicated by a vertical straight line, and the commonly illegible scrawls representing abbreviations in the apothecaries' system are eliminated. The American Pharmaceutical Association recognizes this as well as the other features of the matter, and for years has been persistent in its advocacy of a compulsory metric system.

F. L. PLEADWELL, *Acting.*

NAVY DEPARTMENT,
BUREAU OF SUPPLIES AND ACCOUNTS,
Washington, D. C., October 7, 1921.

To: The Chief of Naval Operations.
Subject: Hearings on Senate bill 2267, entitled "A bill to fix the metric system of weights and measures as the single standard of weights and measures for certain uses."
Reference: Chief of Naval Operations' letter 26266-512, October 6, 1921.

1. In principle, the Bureau of Supplies and Accounts is in hearty favor of the establishment of a metric system of weights and measures. The bureau is not informed as to whether or not it is practicable to adopt the system for use in this country until an indefinite date in the future.

2. It is not desired to have a representative of the Supply Corps appear before the Senate committee in connection with the hearings on the bill.

DAVID POTTER.

OCTOBER 7, 1921.

From: Chief of Bureau of Yards and Docks.
To: Chief of Naval Operations.
Subject: Hearings on S. 2267—Data for department's opinion on S. 2267.

1. The Chief of the Bureau of Yards and Docks is heartily in favor of the adoption of the metric system, but believes this bill is too drastic by prohibiting the use of any other system beginning 10 years after the passage of the act, as there is a large amount of property in the country that has been constructed in accordance with other systems of measurement, which will require repairs and replacements for many years to come, and it is believed that an exception should be made for repairs and replacements of articles purchased or constructed prior to the date that this act goes into effect.

2. It is understood that in certain nations the use of the metric system was quickly popularized by having certain containers so marked that the customer would purchase a fraction of a liter and a penalty accrued to the seller if full measure were not delivered.

3. At one time a manufacturer offered to sell leather measured in square meters, one square meter at the cost of one square yard or nine square feet, giving the customer a decided advantage, but one customer stated that he would not buy by this system for the reason that he could quickly estimate the number of shoe uppers that could be made from a certain number of square feet and could not estimate it quickly from square meters.

4. Of course, there are many cases similar to this where the customer is used to pounds, feet, and other regular systems of measurements, and base their factory product estimates upon certain established rules. An effort could be made to discover such cases and establish equivalent rules for the metric system that could be used to overcome the objections.

C. W. PARKS.

DEPARTMENT OF THE NAVY,
OFFICE OF THE JUDGE ADVOCATE GENERAL,
Washington, October 7, 1921.

From: The Judge Advocate General.
To: The Chief of the Bureau of Navigation.
Subject: Hearings on bill S. 2267—Data for department's opinion thereon.

1. Returned.

2. After careful consideration of the inclosed draft of bill (S. 2267) it is noted that it does not prescribe what punishment offenders are amenable to for violation of any of its provisions, nor is proper provision made therein for its enforcement. Section 6 provides "That rules and regulations for the enforcement of this act not inconsistent with the provisions hereof, shall be made and promulgated by the Secretary of Commerce."

3. It is evident from the wording of section 6 that it is intended that the Secretary of Commerce shall be responsible for the enforcement of the act under such rules and regulations as he may provide. However, an analysis of section 6 shows that as it now stands the Secretary of Commerce is merely authorized to make and promulgate necessary rules and regulations for the enforcement of the act, but he is not expressly charged by the language of said section with the duty of enforcing the provisions of the proposed act.

4. It appears desirable to insert in the inclosed draft of bill a separate section, providing in effect that persons found guilty of violation of any of the provisions of the proposed act shall be deemed guilty of a misdemeanor, and specify therein the maximum penalty to which violators are amenable. It is accordingly suggested that the following new section be inserted in the bill in lieu of section 6, and that sections 6 to 10, inclusive, of the present bill, be numbered, respectively, sections 7 to 11, inclusive:

"SEC. 6. Any person found guilty of willful violation of any of the provisions of this act shall be deemed guilty of a misdemeanor and be liable to a fine not to exceed $500, or imprisonment not to exceed six months, in any court of the United States having jurisdiction in a particular case."

5. The insertion in the bill of this new section would in no way interfere with the provisions of section 7 (now section 6) of the revised bill, for the Secretary

of Commerce could still be charged with the duty of making and promulgating necessary rules and regulations for the enforcement of the act. However, in order that the Secretary of Commerce may be expressly charged under the law with the duty of enforcing the provisions of the proposed act, it is suggested that section 7 (now section 6) be changed to read as follows:

"SEC. 7. The Secretary of Commerce shall be, and he hereby is, charged with the duty of enforcing the various provisions of this act, and he shall, accordingly, make and promulgate such rules and regulations for the enforcement of this act not inconsistent with the provisions hereof as may, in his judgment, be deemed proper. The Secretary of Commerce shall also take such steps as he may deem expedient for giving publicity to the dates of transition specified herein and for facilitating the transition to the meter liergram or metric system."

6. Subject to the foregoing comment, the inclosed draft of bill (S. 2267) is, in my opinion, in proper form, and if enacted into law, would result in accomplishing the purpose sought, namely: "To fix the metric system of weights and measures as the single standard of weights and measures for certain uses."

7. The Judge Advocate General does not desire to designate an officer to appear at the hearings on the inclosed bill.

W. B. WOODSON, *Acting.*

HEADQUARTERS MARINE CORPS,
Washington, October 8, 1921.

From: The Major General Commandant.
To: The Chief of Naval Operations.
Subject: Hearings on S. 2267—Data for department's opinion on S. 2267.

1. Returned.

2. The change to the metric system would be very difficult and very expensive as far as material is concerned, but from a purely military standpoint it would be advisable.

JOHN A. LEJEUNE.

The CHAIRMAN. Is there anything further you desire to place in the record?

Admiral COONTZ. No, sir.

The CHAIRMAN. Thank you very cordially, Admiral Coontz, for your presence here this morning.

STATEMENT OF COL. W. H. TSCHAPPAT, UNITED STATES ARMY, ORDNANCE DEPARTMENT, UNITED STATES ARMY.

The CHAIRMAN. Colonel, you are here representing the War Department?

Col. TSCHAPPAT. Yes, sir.

The CHAIRMAN. We will be glad to hear from you. Kindly state for the record your name and rank.

Col. TSCHAPPAT. W. H. Tschappat, colonel, Ordnance Department, United States Army.

The CHAIRMAN. Colonel, you understand we are considering the bill which has been introduced in the Senate (S. 2267) to fix the metric system as the single standard of weights and measures in the United States?

Col. TSCHAPPAT. Yes, sir.

The CHAIRMAN. Have you read the bill, which was introduced by Senator Ladd?

Col. TSCHAPPAT. Yes, sir.

The CHAIRMAN. We would like to have your judgment and the judgment of those you represent, particularly, as to the contents of the bill, whether you think it is practicable and should be adopted at this time, or in what other way the adoption of the metric system should be brought about, if at all.

Col. TSCHAPPAT. Briefly, the War Department as a whole is opposed to the adoption of the bill. The question of a system of weights and measures affects the War Department in two ways; first, in the question of maps, second, in the question of manufacturing. In both of those ways the War Department is opposed to the change being made compulsorily.

The CHAIRMAN. Would a great cost inure to the Government in the event of a compulsory change from the present system to the metric?

Col. TSCHAPPAT. It is the opinion of those branches of the War Department directly concerned with procurement that the cost would be very great. It is

extremely difficult to give any figures. Figures mean nothing. But it would run to very high figures.

I have an estimate which was made when the question of the adoption of units for the Army was considered immediately after the war. Through force of circumstances, of course, the Army was compelled to use metric units in France. After the armistice the War Department took up the consideration of whether the metric units should be retained for such purposes as scales and maps and the reading of the graduations of sight scales, and an estimate was made at that time on changing certain sight scales from American units to metric units, and also the reverse.

As illustrating the cost of making such changes, we have the example of the proposition of changing the graduation of the sight slide of the small arms rifle from American units to metric units—in other words, from yards to meters. The estimate for making the change on all the small arms in the possession of the Government was $2,678,000.

At the same time an estimate was made upon changing the graduations of sights on mobile artillery, which were then in metric units, to English units. The estimate was $1,000,000.

I take those two cases because they are extremely small units in both cases, although the number of them was considerable.

Upon consideration of those estimates, and other facts connected with the adoption of definite units at that time, the War Department decided to stick to the American units, not making changes, however, upon those parts of gun carriages which were graduated to metric units until replacement of parts became necessary.

The CHAIRMAN. Has the War Department considered the whole subject very carefully, Colonel? In other words, is the opposition active and has it gone into the matter? I assume it has on account of the experience you have had in France.

Col. TSCHAPPAT. Yes.

The CHAIRMAN. That is, is the opposition pronounced?

Col. TSCHAPPAT. The opposition is pronounced in those departments that have to do with the manufacturing industries of the country, in the procurement of manufactured supplies, especially machine supplies. The opposition is most pronounced in the Ordnance Department. Certain branches of the War Department, such as the Medical Department, now use the metric system, and there is no opposition whatever to it.

Another branch of the War Department, the Signal Corps, is in favor of the metric system, because they have to deal with instruments and electrical supplies of various kinds, which are now procurable in the metric system.

The CHAIRMAN. Do you see any reason for legislation that carries an obligation upon the people to accept this system in preference to all others on a specified and arbitrary date? Or do you think it should come about through gradual adoption by the people of the country if it shows a superiority in competition with the present system?

Col. TSCHAPPAT. I should think it should come about by gradual adoption in competition with the present system, if it is to come about.

The CHAIRMAN. In addition to being taught to the young in the schools?

Col. TSCHAPPAT. Yes.

The CHAIRMAN. I am asking this to get your judgment in the matter. If this bill should be passed and become effective in 10 years from date, do you think it would be accepted without complaint by the public? Do you think during the period given for transition we would all become familiar with and adapt ourselves uncomplainingly to the system?

Col. TSCHAPPAT. No; I think there would be a great deal of opposition to it, among the manufacturing industries especially, and also among the mercantile interests.

The CHAIRMAN. Do you find the American or the English system unsuited to the present demands of commerce, trade, and manufacture?

Col. TSCHAPPAT. I think it is well suited, speaking especially of the manufacturing industries, to those industries. The units in the British system are better adapted than the metric units to machine shop work. The meter is too long and the millimeter is also too long for fine machine work as a unit. It must be divided still further.

The War Department, of course, used French artillery to a large extent. Some of it was procured directly from the French, built to metric units, and much of it was manufactured in this country. As a rule the drawings were sent out to

the manufacturers in metric units. The manufacturers, however, transposed them into British units before using them in the shops. That is true in the main. They did that because they were afraid of the delays that would result from the mechanics not being familiar with the metric units, in addition to the necessity of supplying the shops with metric measuring instruments.

The CHAIRMAN. Colonel, have you any data that you desire to place in the record, of any kind, which you think would be useful or helpful to the committee?

Col. TSCHAPPAT. I have here the original copy of the original memoranda prepared under date of April 22, 1920, on the subject of the metric system for the Army. I have also an extract from an article headed, "Gauging," by Lieut. Col. E. E. Peck, Ordnance Department, United States Army. Also, I have an article on "Experiments in the Use of the Metric System," prepared by J. P. Jones, captain, Ordnance Department, United States Army, and W. C. Hedgecock, captain, Ordnance Department, United States Army, January 17, 1919.

These are original papers, but I can furnish copies of them.

The CHAIRMAN. All right, Colonel, if you will.

(The papers referred to are here printed in full, as follows:)

EXTRACT FROM ARTICLE ON "GAUGING," BY LIEUT. COL. E. C. PECK.

Gauge is a name given to a large number of instruments and appliances for determining dimensions, capacity, quantity, force, etc.

Many gauges are distinguished by special names indicating their use, such as rain gauge, steam gauge, heat gauge, etc.

It is a well-known fact that gauges of some description have been used since man first began to contrive conveniences for himself. The standards of weight, measure, and volume mentioned in the Bible are gauges. The instruments and appliances used in building the pyramids were gauges.

In fact it has been apparent from the beginning of time that standards for determining dimensions, capacity, quantity, force, etc., are not only necessary but aid materially in conducting all kinds of commerce and business.

In bargaining for a quantity of material it is necessary to have a standard unit acceptable to both buyer and seller to determine whether the quantity bargained for is understood by both and the bargain carried out.

Tribes, states, and countries used gauges originating with themselves, and probably the tribe or state doing the most trading with the neighboring countries succeeded in establishing their standards in other countries and hence the most-used gauges were handed down to us. It certainly would have been much better for the present generation if there had been a little more cooperation among the ancients in regard to standardization and then we would not have the heterogeneous collection of gauges or units that we are all familiar with. There is a consistent and steady forward movement toward an international standard and there is no doubt but what the near future will see rapid strides in this direction. The World War has done more to help this movement than all the propaganda of the last decade.

It has shown in a very practical way the delay, trouble, and cost of producing necessary material to a number of different standards. It has shown that a very great world economy will result in the adoption and use of international standards.

It must be evident to everyone that all business and commerce will be done with less expense for the service rendered if standard specifications were in use and had the same meaning all over the world.

If steam and water pipe, bolts, nuts, and screws were interchangeable in every country it would promote business and effect an economy greater than any one thing now before the public.

It would seem like a logical statement to say that some one system of standards ought to be enough better to win over the entire world by its greater utility, but this has not proved to be true.

First, we have the natural pride of every country against giving up its own standard for that of another. Second, the objection of the industries themselves to the cost involved in duplicating their gauges, tools, and fixtures to produce to the new standard and keep up repairs on the old. Again, there has been no one system of standards on which there is a majority agreement as its outstanding claims over other systems.

The two systems which most concern this country are the English and metric. Both are used extensively, each is legal, and each has its warm advocates.

It seems obvious that the outstanding advantages of the metric system have not been sufficient to supplant the English in this country. To me the outstanding advantage of the metric system is that all subdivisions are multiples of 10 and hence in calculations it is only necessary to move the decimal point in the reduction from unit to unit. Great advantage is also claimed in that the units of weight and volume are derived from the unit of measure, but to me this is of little account, as for accurate work one does not want to originate his own standards, but prefers to obtain them from the Bureau of Standards, and they can compare a standard without regard to its origin.

One advantage claimed for the English system is that most subdivisions are made by successively halving each unit. If these arguments are adhered to by the advocates of each side, they both fail because their methods result in units the size of which are impracticable, based on experience.

In the English system, beginning with the inch and halving for each subdivision, we finally reach the units $\frac{1}{64}$, $\frac{1}{128}$, $\frac{1}{256}$, $\frac{1}{512}$, and $\frac{1}{1024}$, all of which are awkward to handle and not readable on the well-known micrometer without estimating. To obviate this difficulty, the inch is divided into tenths, hundredths, thousandths, and ten-thousandths, and all of these decimal units are practicable and usable units.

In the metric system, the first subdivision of the meter is the decimeter, a unit $\frac{4}{5}$-inch long, of no utility and rarely used. The next unit is the centimeter, a unit too large for good work and too small for use in distance measurements. The next is the millimeter, 0.03937 inch, the most widely used unit because of the adaptability of its size value. Many industrial enterprises require no greater accuracy than a millimeter, and, therefore, as this unit is about as fine as can be used on a steel scale, it is sufficient for their needs.

For tools and fine accurate mechanisms, the millimeter is too large and so is the next subdivision, $\frac{1}{10}$ millimeter, which is 0.0039 inch. The great bulk of good work in our machine-tool, automobile, and tool-making industries require units between $\frac{1}{10}$ and $\frac{1}{100}$ millimeter, as one is too coarse and the other too fine.

The result of this is the halving and quartering of the millimeter and the $\frac{1}{10}$ millimeter to get the usable units approximating $\frac{1}{100}$, $\frac{1}{1000}$, and $\frac{1}{10000}$ of an inch.

Thus it will be seen that the advocates of both systems use what the other claims is an inherent fundamental of his favorite system, and this, of course, proves the utility of it.

The impracticable size of the units of the metric system is, in my judgment, the greatest stumbling block to its adoption and if with the start it has had in Europe, this country fails in its progressive attitude to adopt it willingly, it would be wrong for Congress to try to force it by compulsory legislation.

If when the meter was adopted they had left all romance and sentiment out of the question and made the meter 10 English inches long, the metric system would be in universal use long ago. They, however, took as the length of the meter the theoretical value of the one ten-millionth part of the distance from the Equator to the Pole, and after esablishing this figure, found an error in the calculation, so that now we haven't even this sentimental advantage.

If the meter had been 10 English inches long, a decimeter would be the well-known standard inch, and the other decimal subdivisions the well-known decimals of an inch, all of which are thoroughly practical working units. The present 10-foot pole used largely would be 12 meters long. Four meters would have easily been substituted for the yard, as the error is only 1½ per cent.

Two dekameters is within 2 inches of the English rod and as a unit would be satisfactory. The mile would be 6,333 meters, just as easy to handle as 5,280 feet.

The adoption of the 10-inch meter would have simplified at once the greatest stumbling block to an international standard thread system; as it stands now, there is little hope that this can be accomplished in the near future.

The English system of pitches is built up in a certain number of threads per inch and admits of a uniformity in pitches with a minimum amount of gearing. The metric is built up with the distance between centers of threads expressed in millimeters and fractions thereof. For example: A 2-millimeter screw has a thread 0.45 millimeter pitch; a 3-millimeter screw has a thread 0.55 millimeter pitch, etc.

If the meter had been 10 inches, the metric threads could have been expressed in whole numbers per decimeter and this would agree with present practice, and would fit in with the United States system.

The cube of a certain number of centimeters representing a convenient and usable unit could be the liter, and the weight of a certain number of cubic centimeters of water at greatest density could have been the gram. This would have tied the system together and provided a means of reproduction.

WAR DEPARTMENT,
OFFICE OF THE CHIEF OF STAFF,
Washington, April 22, 1921.

Memorandum for The Adjutant General of the Army:
Subject: Metric system for the Army.
The Secretary of War directs:

I. That there be published to the service an order in substance as follows:

"As an incident to the World War, metric units of weight and measure were necessarily used in instruction and training. As a result, more or less confusion now exists as to what units should be used normally.

"Hereafter the customary British units of weight and measure (including the degree Fahrenheit) will, as far as practicable, be used throughout the Army as they were before the war.

"Matériel and equipment now graduated in metric units will, when worn out, be replaced by articles graduated in British units in such manner as will cause all parts of a regiment or similar organization (or smaller organization when there is no regimental organization) to be provided at all times with matériel and equipment graduated alike.

"This order shall not be construed to prevent the utilization of metric units of weight and measure when desirable in connection with specifications and contracts, medical and scientific supplies, scientific research and developments, international meteorology, foreign maps, monographs and handbooks, and similar subjects."

II. That, except as noted below, the attached papers be filed in your office:

Memorandum dated September 11, 1919, from the Chief of Field Artillery to the commandant, School of Fire, Fort Sill, Okla., and accompanying papers, be returned to the Chief of Field Artillery as requested.

III. That for the information of the Interdepartmental Board of Meteorology, the Army representative (Lieut. Col. Wm. R. Blair, Signal Corps, care of Office Chief Signal Officer) be advised by letter of the substance of the above order.

WM. LASSITER,
Colonel, General Staff, Assistant Director War Plans Division.

WAR DEPARTMENT,
OFFICE OF THE CHIEF OF STAFF,
Washington, April 22, 1920.

Memorandum for the Chief of Staff:
Subject: Metric system for the Army.

I. PAPERS ACCOMPANYING.

1. Memorandum dated September 5, 1919, from the Chief of Field Artillery to the equipment section (Col. Dougherty), Operations Division.

2. Memorandum dated September 10, 1919 (061.02A–M Office, C. of E.) from the Chief of Engineers to the equipment section, Operations Division.

3. Indorsement dated October 11, 1919, from the Chief of Field Artillery to the equipment section, Operations Division, transmitting:

Recommendations of the Field Artillery Board, dated September 27, 1919, inclosing:

Memorandum dated September 4, 1919, from Maj. G. R. Allin, Field Artillery, technical staff, Ordnance Department, to the chief of Field Artillery, inclosing:

Copy of letter dated December 14, 1918, from the Chief of Ordnance to the Chief of Field Artillery.

4. Similar letters dated September 24, 1919, from The Adjutant General of the Army to:

The commandant, General Staff College (003.11 Misc. Div.).

The Chief of Engineers (003.11 Misc. Div.).
The commandant, Army Service Schools (003.11 Misc. Div.).
The Chief of Ordnance (003.11 Misc. Div.).
With replies dated respectively September 27 and 29 (C. of E. 061.02A-M2) 29 (003.11), and October 3, 1919, (O. O. $\frac{003}{8}$).

5. Indorsement dated October 25, 1919, from the Chief of Ordnance to The Adjutant General of the Army (O. O. War Dept. 003/.2).

6. Joint memorandum dated October 30, 1919, from the Chief of Field Artillery and the Chief of Coast Artillery to The Adjutant General of the Army (O. C. C. A. 003/A1).

7. Draft of a memorandum for the Chief of Staff prepared in the equipment section, Operations Division, in November, 1919.

8. Memorandum prepared in December, 1919, from the chief training and instruction branch, to the director War Plans Division.

9. Letter dated December 17, 1919, from The Adjutant General of the Army to the commandant, the Cavalry School (003.11 Misc. Div.), with reply dated December 23, 1919 (003 Metric System).

10. Letter dated December 29, 1919, from the commandant, the Infantry School, to The Adjutant General of the Army (003).

II. THE STUDY PRESENTED.

Whether or not the Army should adopt the metric system of weights and measures.

III. FACTS BEARING ON THE STUDY.

1. The question of the use of the metric system of weights and measures in the Army arose apparently from the fact that the sights, fuze setters, range-finding instruments, range tables, etc., pertaining to the mobile artillery and machine-gun matériel now in use in the Army are prepared for use in units of the metric system, whereas the sights of rifles are graduated in yards, and the existing maps of the United States and the fixed coast defense armament and range tables connected therewith are based upon the customary British units (including the degree Fahrenheit).

2. An authoritative statement as to what units of weight and measures are to be considered as standard in the Army is evidently necessary, and the sooner it is issued the better. The question is constantly arising, for example. in the graduation of instruments, in the dissemination of meteorological data to troops, in the preparation of range tables, and in the big subject of instruction and training. At the present time, at least one of the service schools is using the meter and kilometer in tactical instruction while others are using the yard.

3. The statements and recommendations concerning the use of the metric system made in the above-mentioned papers are many and various. and serve well to bring out the fact that this question is one that can not be decided in the Army by the Army without a thought of the rest of the country. A summary of these papers is attached hereto and marked "Appendix A."

One of the most obvious lessons of the World War is that in a national emergency the Army is brought into intimate relations with practically every industry and with people in all walks of life, and that a modern war is prosecuted successfully only by the united efforts of all classes of people. Anything that would tend to embarrass this unity of effort should be avoided.

Incidentally, the war also showed that the American officer or soldier can handle and adapt himself to the use of metric units when called upon to do so.

4. The subject of the adoption of the metric system in this country is one that has been before the public periodically since the year 1786. Great men have been in favor of its adoption, equally great men have been bitterly opposed thereto; volumes have been written on both sides of the question, and in the records of Congress can be seen many lengthy arguments both for and against it.

The use of the metric system in the United States was legalized in 1866.

There are now societies, in both the United States and Great Britain, actively working to popularize the metric system with the object in view of later securing its adoption by law, and there are other societies which oppose the

former most strenuously. At the present time there seems to be no reason to believe that Congress will. in the near future. adopt this system for the country.

5. A reading of the literature distributed by these societies shows that. in general. the persons most interested in the adoption of the metric system are those whose daily work brings them into contact more or less with metric units, such as scientific men. educators, exporters to metric countries. electrical and medical men, chemists, druggists, etc., while those opposed include engineers and manufacturers primarily interested in domestic and nonmetric foreign trade. and those persons who have taken it upon themselves to represent the so-called common people. the clerks. the laborers. the tradesmen and the farmers, whose interest in the metric system is practically nonexistent.

6. The question as to the advisability of the adoption of the metric system for the entire country is not called for in this paper and will, therefore, not be discussed. From the experiences of countries which have adopted this system, however, the fact seems to have been clearly established that it is most difficult to stamp out by force of law the use of units of weight and measure to which a people is accustomed. The metric system is a wholly artificial one which is well suited to work involving calculations, whereas the systems in vogue in nonmetric countries are the results of long periods of development by the process of natural selection of units, and are better suited to the needs of the man that works with his hands. Apparently in no country, even after 50 or 60 years of legal enforcement of the use of the metric system, have the new units entirely supplanted the old in the minds and daily lives of all its common people especially in the districts which are more or less removed from the eye of the law. The result is that there is found in use in such countries a mixture of the units of two system, a state of affairs that is bound to be the cause of more or less confusion.

In this country, a great majority of the people belong to the classes mentioned above as having little or not interest in the metric sysem. These classes would be the last to use the metric units in case they were legally adopted to the exclusion of any others, yet from these classes will come the bulk of our future armies.

7. In 1894 the Secretary of War approved an order to the effect that all requisitions, invoices, receipts, and returns pertaining to medical supplies would be in accordance with the metric system of weights and measures.

8. The metrc measures referred to herein comprise the measures of length, surface, and capacity, and do not include angular or circular measure. The mil (1/6400 of a circumference) has nothing to do with the metric system, and the question of its use is not involved in this paper.

IV. OPINION OF THE WAR PLANS DIVISION.

1. That the fact that our mobile artillery (except railway artillery) and machine gun matériel and related instruments, range tables, etc., are prepared for use in metric units is an unavoidable incident of the recent war and should have relatively little weight in deciding the question as to whether or not the entire Army should adopt the metric system.

2. That continuing such matériel and equipment in service should inconvenience, and then but slightly, only the officers serving with companies, batteries and possibly battalions equipped therewith.

3. That, except in certain cases not involving training, the standardization of the units of weight and measure in use in the Army is essential, and that confusion would result in prescribing that one or more arms of the service use the metric system while the others use the British system.

4. That at present there is in the Army considerable confusion caused by the absence of a definite post-war statement as to what units should be normally used.

5. That it would be a great mistake for the Army to adopt the metric system before it is adopted by Congress for exclusive use throughout the entire country.

6. That there should be published to the Army an order which will prescribe that the customary British units of weight and measure (including the degree Fahrenheit) are to be normally used, but which will permit the use, until worn out, of matériel and equipment now graduated in metric units and will not disturb activities in the Army, not intimately connected with training, in which the use of metric units is desirable.

V. ACTION RECOMMENDED.

Memorandum for The Adjutant General of the Army.

VI. CONCURRENCE.

1. Concurrence in the action recommended has been obtained from the following: Director of Operations (Col. Wyllie); Director of Purchase Storage and Traffic (Col. Smither); Director of Military Intelligence Department (Col. Dengler); Chief of Field Artillery (Col. King); Chief of Coast Artillery (Col. Murphy); Chief of Ordnance (Col. Ruggles); Chief Signal Officer (Col. Saltzman).

2. Through the members of the War Department technical committee, opinions were obtained from practically all the bureaus and services on the question of the use of the metric system.

A summary of these opinions is attached hereto and marked "Appendix B."

The only bureau or service that recommended the adoption of this system by the Army was the Signal Corps.

3. In this connection the Chief of Field Artillery, who is not represented on the War Department technical committee, states in part:

"The following are the only complications which are now foreseen as liable to occur in the Field Artillery as the result of this order:

"(*a*) Most instruments now used by Field Artillery are graduated in the metric system.

"(*b*) Range tables now published for the use of the Field Artillery are published in the metric system.

"From this it is evident that if the metric system is abandoned it will be necessary for Artillery officers to convert units of the metric system into units of the British system. Furthermore, it will be necessary to reprint range tables and other publications. The first complication mentioned is not regarded as of vital importance. In connection with the second complication, it is recommended that if the proposed order is published a reprint of range tables be undertaken as soon as practicable.

"The above complications can not be cured by any change in wording which would not change the spirit of the proposed order. Therefore, no change in wording is suggested. Attention is invited to the fact that the mil is neither a unit of the British system nor the metric system. It is urged that no order be published which will prevent the use by the Field Artillery of this most convenient unit of angular measure.

"It is not believed practicable to change the graduations of instruments now in use by the Field Artillery from metric to British units on account of the expense involved, which it is believed would amount to several million dollars."

4. Lieut. Col. W. R. Blair, Signal Corps, the Army representative on the meteorological board appointed by the Secretary of War, under authority of the President, for consideration of questions in connection with the collection and dissemination of meteorological data, states that while the meteorological board is inclined to favor the use of metric units, still meteorological data can be furnished the Army in whatever units it desires, and if a decision could be reached on that point it would, to an appreciable extent, simplify the work of the board.

WM. LASSITER,
Colonel, General Staff, Assistant Director, War Plans Division.

APPENDIX A.

SUMMARY OF THE STATEMENTS AND RECOMMENDATIONS CONTAINED IN THE PAPERS ACCOMPANYING THE MEMORANDUM ON THE SUBJECT "METRIC SYSTEM FOR THE ARMY."

1. The Chief of Engineers believes—

That the Army should adopt the metric system only if adopted by the country as a whole, and in adopting it should do so in its entirety.

That on account of the enormous cost of changing the existing equipment to the English system some alternative method should be adopted.

That it will be necessary for several years to depend upon the 1:62,500 scale, 10-foot-interval contour interval maps of the Geological Survey for military operations.

That it is possible to take the maps with foot contour interval and interpolate thereon multiples of metric intervals by office methods, but this would necessarily give only an approximate map in relief, which in irregular country would be subject to large errors, and that the cost of doing this for the maps within a hundred miles of the coasts and borders and of preparing a special edition of the same for Army use would somewhat exceed $1,000,000.

That in the measurement of horizontal distance from maps it is immaterial what system of units is used, and that therefore the contour interval is the deciding factor in the use of the metric system so far as maps are concerned.

That, assuming that our mobile artillery material be retained in the metric system and metric intervals be retained in feet, the only difficulty encountered by the Artillery officer would be in determining differences in elevation, and this would be overcome by the use of a conversion table or factor.

That in his opinion there is a tendency to lay too much stress upon map firing by the Artillery; that this firing requires a comparatively large scale map of improved and accurate; and that the small scale of the Geological Survey maps would prohibit their use for such work.

That the cost of preparing such large scale maps of more than a few of the most vital strategic sectors in the United States is prohibitive, so that for the limited cases in which map firing may be used it appears that to use the existing system of units now found upon maps in the United States can be done with but little inconvenience to the Artillery and would result in greater uniformity than to adopt a metric contour interval for the comparatively small number of maps prepared by the War Department.

That a conference of arms interested in the subject before a committee of the General Staff would be of considerable value to all concerned.

2. The Field Artillery Board states—

That from replies to letters received from, and from interviews with, a considerable number of Field Artillery officers the consensus of opinion appears to be decided in favor of the adoption of the meter as the linear unit of measure.

That some of the reasons for this are that most Field Artillery officers have become accustomed to using this unit; that its subdivisions and multiples are based on the decimal system; that the meter is the linear unit in most other countries and to some extent for scientific purposes in this country; that practically all instruments in use in the Field Artillery are now graduated in meters; and that the change back to graduations in yards would be costly.

That, on the other hand, the British system of linear units is still in general use in this country and probably will be for many years; that it has apparently been definitely decided to use feet and yards as the linear units in the preparation of military maps of this country and to use 1,000-yard grids thereon; that, if the Field Artillery uses the meter and maps with metric grids while the rest of the Army uses the yard and the corresponding grid, some inconvenience will result.

That the advantages of the metric units are so great and so generally favored that it is believed desirable but not essential to have a kilometric rather than the 1,000-yard grid placed on all our (Field Artillery) military maps and to have the contour interval in meters rather than in feet; and that it would also be desirable to have the same grid used by the infantry and the staff, as this would facilitate the interchange of information and the issuing of orders.

That even if these changes can not be brought about, it would be advisable to use the metric system of linear measure in the Field Artillery, as the officers are familiar with this system and most Field Artillery instruments are now graduated for it and there appears to be no real difficulty to overcome in its adoption and use; and

That, as a consequence, the units of linear measure contained in all range tables, drill regulations, and handbooks for Field Artillery should be those of the metric system.

Specifically, the Field Artillery Board recommends—

That the metric system of linear units and units for range table data be adopted for the Field Artillery and that the adoption of the metric system for the Army be recommended.

That metric scales, grids, and contour intervals be used on all military maps, or, if this is found to be impracticable, that at least graphic scales in meters and metric grids be placed on all military maps.

That steps be taken to induce the other arms of the services and the staff to adopt the meter as the linear unit of measure; and

That other services of the Army which furnish data of any kind to the Field Artillery be requested to furnish the same in terms of metric units.

These recommendations of the Field Artillery Board are neither approved nor approved by the Chief of Field Artillery in transmission to this office.

3. The Chief of Field Artillery, in a memorandum which he states is not the result of a deep study of the subject, states—

That he is strongly in favor of the adoption of metric units for the graduations of ordnance and for the scales of maps.

That the majority of Field Artillery officers have been trained to establish ranges and distances and compute firing data using metric units.

That the study of all European operations in the future will necessarily be done under this system.

That the range tables and instruments of the Field Artillery are now in metric units and that it is estimated that it would cost about $500 per battery to regraduate the range scales, fuse setters, and range finders.

That factors which discourage the change from the English system are the expense involved in changing the existing maps of this country and the difficulty of coordinating civilian standards, textbooks, instruments, etc., with the metric system; and

That other phases which must be considered are the effects of such a change on the operations of other arms of the service and the probability of being forced to use metric maps and instruments in future operations.

4. In a joint memorandum, the Chief of Field Artillery and the Chief of Coast Artillery point out—

That the desirability of the standardization of units of measurement used in the service, as well as the standardization of the method of graduating all service instruments and weapons, is clearly recognized; but in order to secure the rigid accomplishment of this desirable result it would be necessary, whatever unit might be adopted, to make very extensive changes in the graduation of one or more large classes of service matériel, and that these changes would necessitate correspondingly large expense, which can not be justified unless very real advantages are to be secured or unless there is no other way of obviating the disadvantages due to the lack of a standardized system.

That while the advantages of the metric system are well known and well recognized, there are serious difficulties in the way of its adoption by the Army, namely, the difficulty of utilizing in time of war a system of measurement with which the mass of the people is unfamiliar and the fact that the sight bar of the present Infantry rifle is graduated in yards.

That it would, therefore, seem to be wise to retain the English units of distance and the present graduation on the sight of the rifle, in so far as the Infantry branch of the service is concerned; and, if this policy be adopted, that the question as to whether or not the machine guns which are now graduated in meters should be regraduated in yards is a matter for the Infantry to decide.

That a careful examination of the situation as regards existing mobile Artillery matériel seems to lead to the conclusion that the expense of regraduating this matériel is practically prohibitive, and that the desirability of standardization must be sacrificed at this point.

That the individual Artillery private, as distinguished from the Infantry private, is not ordinarily concerned with the units which are being used by the battery, but that the technical and more highly trained personnel of the battery must, of course, be familiar with the units they are using.

That as the last-named personnel is drawn as far as possible from among men already trained in technical pursuits, the difficulties of utilizing the metric system of measurement are not believed to be serious enough to give concern.

That if the metric system be adopted for the Artillery, the grid system and the system of coordinates of all maps must be expressed in meters.

That all maps should have printed upon them graphic scales both of yards and meters and a conversion table for feet to meters.

That any linear scales placed in the hands of the Infantry would be in yards, while those used by the Artillery would, of course, be in meters.

That the existing system of fire control and direction for seacoast fortifications uses yards for linear measurements, and that the prohibitive expense of changing to the metric system and the little or no advantage to be gained thereby make any change inadvisable.

That the most important function of railway artillery is to supplement the fixed fortifications in the defense of the coast line, in which case the standard

Coast Artillery long-range fire-control system, and consequently the English units of measurement must be used by them; and

That, however, when operating in the field against land targets, railway guns should use the same system of fire control and direction as is provided for heavy coast artillery.

The recommendations in this joint memorandum are specifically—

That the metric system be adopted for all mobile artillery other than railway.

That the existing system be retained for fixed coast fortifications.

That railway artillery be provided with standard coast fire-control equipment and gun equipment similar to that used by other heavy mobile artillery.

3. In reply to a request for his opinion on this subject, the commandant General Staff College, Maj. Gen. McAndrew states—

That the changing of metric data to the English system involves a very simple calculation, and when desirable a metric scale and Lambert squares can be placed with little expenditure of time and trouble on any map.

That the advantages in handling metric units and scales and transforming to English units when desired are considerable and that that would be preferable to changing existing equipment; and he recommends—

That the using of the metric system for range units and range-finding instruments in the computation of firing data for both mobile artillery and machine guns be prescribed.

4. In reply to a similar request, the commandant, the Army Service Schools states—

That the cost of changing the graduation of instruments must be balanced against the cost of altering all existing maps.

That it is possible that Congress and the people would forbid a change to the metric system.

That it is by no means certain that our next war will be fought on foreign soil.

That an officer should be required to know both systems.

That there is no insurmountable obstacle to using instruments graduated in meters with a map graduated in yards, though care will have to be exercised to avoid mistakes; and

That any expansion of our forces on outbreak of war would bring in many not familiar with the metric system.

Specifically he recommends:

That maps be graduated according to the English system; and

That instruments graduated in meters be retained until worn out and new instruments be graduated in yards.

5. The Chief of Ordnance states that he has no preference for either system providing nothing is altered except the graduations of sights, range drums, etc., but that he would be materially interested in a change from the English to the metric system which affected general manufacturing dimensions; and submits the following data on the approximate cost of changing range and other graduations on sights and fire-control instruments from the metric to the English system and vice versa:

"The table is based upon making the necessary changes in all serviceable material on hand:

Material.	Metric to English.	English to metric.
Small arms and machine guns	[illegible]	$2,673,000
Mobile artillery	1,[illegible]	[illegible]
Bomb sights		[illegible]
Coast artillery		[illegible]
	1,[illegible]	3,673,000

"Of the item in the above table pertaining to the change in small arms and machine guns from the English to the metric system approximately $2,500,000 is required for the change in the rear-sight leaf of 2,000,000 rifles, Model 1919, and [illegible] Model 1903. If no such change is in contemplation, this amount may be deducted from the total of the third column of the table.

"The item $[illegible], under Coast Artillery, contemplates a change only in range drums and other graduations involving range in Coast Artillery fire-

control instruments. It does not contemplate a change in angle measuring instruments. This entire item may also be deducted from the third column, providing no change is contemplated in Coast Artillery material. The items referred to in this and preceding paragraphs were included to make the estimate complete."

8. In the draft of a memorandum prepared in the equipment section, Operations Division, the opinions and recommendations contained in the above papers were summarized. No new points were brought up, and the suggested recommendations were apparently not concurred in by all members of the section. These recommendations were designed to carry out the joint recommendations of the Chief of Field Artillery and Chief of Coast Artillery in so far as their arms of the service were concerned, and to refer the subject to the Infantry-Cavalry board for recommendations as to the action to be taken with respect to those arms.

9. The training and instruction branch, War Plans Division, dissents from the action proposed in the draft of memorandum prepared in the equipment branch, Operations Division, and states that the action proposed is unsound in principle, tending toward duplication of effort, to complication in the handling of technical matters within the service, and liable to cause confusion in emergencies.

That the advantages of the metric system are merely those of the decimal system, and that the English units can be made decimal.

That in the above papers too much weight has been attached to the fact that certain equipment is now graduated in meters, and that it will cost a large sum to change them;

That little or no thought appears to have been given to the effect of having the Army, in whole or in part, adopt the metric system, while all other United States agencies (Federal, State, commercial, and civil) adhere to the English system;

That in time of war operation maps must be the same for all arms and services and that the grid and coordinates for all such maps must conform to one system of linear measurements;

That operation orders, annexes, reports, etc., must follow the map system, and all maps, textbooks, field service and drill regulations should conform;

That it is believed that to the National Guard and temporary officers and to drafted men distance in meters and kilometers does not now mean more than a map measure or an instrument adjustment and not an actual distance on the ground;

That in any future war we may have Great Britain and Canada for allies and both use the English system; and finally

That the decision in this matter rests on more vital and broader questions than those accepted as determining factors in the draft proposed by the equipment section and should be given further consideration.

10. In reply to a request for his opinion and the general opinion of the officers of his command on this subject the commandant, the Cavalry School, states it was the unanimous opinion of the school staff—

That the metric system should not be adopted in the Army until it has been adopted for the Nation by Congress.

That such adoption by Congress is highly desirable.

That in the interim there is no necessity of changing the sights on rifles, inasmuch as distances are estimated in yards and range finders are graduated in that unit.

That a simple instrument which would have meters at one end and yards at the other could be manufactured at very small cost for the use of officers.

That there appears to be no possible correction of our irrational system of scales in yards and contour intervals in feet that will not involve an enormous expenditure of money for resurveys and the making of new maps.

11. In reply to a similar letter, the commandant, the Infantry School, states that a subcommittee of the advisory board reports—

That if a change is to be made and a change is recommended this is the logical time.

That the use of the metric system is permitted in most civilized nations, including Great Britain and the United States.

That the adoption of this system, the logical system, has advantages that need not be enumerated, but may be compared with our present monetary system and that of the British.

That by making a quadrillage based on the metric system on our existing maps they at once become usable in this system as far as distance is concerned.

That in spite of the fact that the metric system has been legalized by Congress it has not come into general use in this country.

That on account of the necessity of taking over from France a large amount of material graduated in meters at the beginning of the World War, and of thereupon continuing the use of the system when our own material became available, the use of the metric system in the Army was accidental rather than rational, and that this should be kept in mind in determining the future policy.

That from a rational viewpoint the Army—that is the entire Army—should not adopt the metric system because of the expense involved in changing weapons, instruments, and maps, because it would add to the time required for the instruction of recruits and officers in a strange system, and because in case war with Great Britain or Canada occurred, we would have to use non-metric maps.

That the difficulties in using maps in English units with the present equipment are considerable, but not prohibitively so, and it is not logical to impose upon the Infantry and Cavalry, the Coast Artillery, and the special services which together compose the great bulk of the Army, a strange and unusual system merely because it is more convenient for a small part of the Army.

That it is recommended that the metric system be adopted for the Field Artillery but not in any other arm or branch of the service, and that existing orders requiring the use of the metric system in the preparation of army maps be amended accordingly.

The commandant then states—

That after a discussion of the report of its subcommittee, a tie vote resulted in the advisory board as to the adoption of the metric system, one officer who voted against it stating that if there should be any likelihood of the whole country adopting this system, or should the Army by adopting it lead to its adoption by the country in a reasonable time, he would change his vote.

That personally he (the commandant) believes that we should not have a different system for the Field Artillery from that which is in use by the other arms.

That he does not see how the adoption of the system would require the remapping of the United States, but that the present maps could be made available for use by superimposing upon them the necessary lines and data.

That the other objections against the adoption of the system should be carefully weighed.

That all seem to agree that the metric system would be preferable for use of our entire country.

That the adoption of the metric system by the Army at this time when it is starting on its work of vocational and educational training would add considerable to the efforts that are being made by educators throughout the country to establish the metric system in our schools.

That, in spite of the difficulties attendant upon the adoption of the system at the present time, they are not insuperable; that the final results would be a betterment of work in the Army and encouragement to the entire country, and therefore he favors the adoption of the metric system for the Army.

APPENDIX B.

A SUMMARY OF THE STATEMENTS SUBMITTED BY THE SEVERAL BUREAUS AND SERVICES REPRESENTD ON THE WAR DEPARTMENT TECHNICAL COMMITTEE ON THE SUBJECT: "METRIC SYSTEM FOR THE ARMY."

1. *Question (a)* Should the entire Army adopt the metric system?

Signal Corps.—Metric system should be adopted by the entire Army.

Engineer Corps.—The adoption of the metric system by the Army should only follow its adoption by the country as a whole.

Transportation Service.—It is not believed practicable for the entire Army to adopt the metric system until it is prescribed for the entire country by legislative action.

Chemical Warfare Service.—It would be inadvisable at this time to attempt to make the metric system of weights and measures obligatory in the Army. This conclusion is arrived at notwithstanding the appreciation in this office of serious advantages of the metric system.

Air Service.—This office stated verbally through Capt. Reardon that the Army should not adopt the metric system.

Ordnance Department.—The answer to this question is "No." The Army can not adopt the metric system except for such purposes as involve the use of the results of measurements exclusively within the Army. It will not be practicable to go outside the Army and buy things by the kilogram or by the meter in this country. Consequently, things so procured by the Army should be measured by the British system both in procurement and in handling within the Army. As examples of things which it will be impossible for the Army to designate in metric units in advance of the adoption of that system by the entire country may be mentioned as pertaining particularly to the Ordnance Department.

(1) Raw material, such as iron ore, pig iron, steel, cotton, acid, alcohol, etc., all of which are quoted on the country's markets by the pound or ton.

(2) Dimensions on manufacturing drawings. The machinery of the country is based on British units. A mere conversion of metric to British units for the purposes of manufacture is impracticable without actual changes in dimensions and tolerances. No machine shop in this country would undertake to manufacture a gun carriage the drawings for which are in metric units.

Motor Transport Corps.—It is not believed that the entire Army should adopt the metric system until the country does so, and the final result for the Army will probably be a compromise between the two systems.

Coast Artillery Corps.—The reply to this question is in the negative.

Quartermaster General's Office, Purchase and Storage.—In the opinion of this office, the Army should not adopt the metric system.

Surgeon General's Office.—This office stated verbally through Col. Whitcomb that as things stand now the Army should not adopt the metric system.

Construction Division.—(*a*) As an organization the Construction Division believes that the adoption of the metric system by the United States for all commercial purposes would be most desirable. The Army should adopt the metric system only when it has been made the official system of the Government by proper congressional action.

2. Question (*b*). State any complications that would arise in your bureau if there should be published to the Army an order in substance as follows:

The customary British units of weight and measure (including the Fahrenheit thermometer scale) will be used habitually throughout the Army, except in connection with medical supplies and except where other units may be necessary in connection with matériel, and equipment now graduated in units other than British. Matériel and equipment of this nature, when worn out or obsolete will be replaced by articles graduated in British units.

3. Question (*c*). Suggest changes in the wording of the proposed order which would obviate the complications feared or any other objections, but at the same time would permit the order to carry the original idea to the Army at large.

Signal Corps.—Adoption of the order as given would prevent the use of the international as well as the universal use of the measurements of radio wave lengths. Will prevent international cooperation in meteorology, which is becoming more and more necessary. The metric system is used at present in obtaining and disseminating meteorological data to the several arms. The term "when worn out" is indefinite, as it would permit instruments employing different scales being used in the same unit at the same time. The several services must change simultaneously, because, as is the case with meteorological, there is sent out from a corps, by radio, data to be used by several organizations and different branches of the service.

If the order is to be adopted it is recommended that it be written as follows:

The customary British units of weight and measure will be used habitually throughout the Army, except with medical supplies, radio wave lengths, and in connection with scientific research and developments and except where other units of measure may be necessary in connection with matériel and equipment now graduated in units other than British. Matériel and equipment of this nature, when obsolete, will be replaced by articles graduated in British units.

Engineer Corps.—Proposed order apparently satisfactory.

Transportation service.—Proposed order satisfactory.

Chemical Warfare Service.—The proposed order is satisfactory to this office. This, of course, is assuming that the statement "except where other units may be necessary in connection with matériel and equipment" would include laboratory and scientific apparatus, which are quite often made up in metric units.

Air Service.—Proposed order apparently satisfactory.

Ordnance Department.—If the proposed order were published, replacements of range scales on sights and other instruments pertaining to the mobile Artillery would have to be graduated in yards instead of meters. The mobile Artillery now uses the metric system exclusively for ranging measurements except for weight of projectile. It is believed that changes in this usage should be made only as entirely new material is put into service; that is, new sights or instruments provided for the present material should use the metric system.

In rewriting the order, the parts in brackets, "including the Fahrenheit thermometer scale," should be cut out. Meteorological data is usually reported by the centigrade scale. The words "worn out or" in the next to the last line should be cut out.

Range tables at present in preparation and an extensive ballistic table are being developed on the metric basis.

Motor Transport Corps.—The Motor Transport Corps is interested in this matter only to the extent that in certain of its specifications providing tests, especially those conducted at the Bureau of Standards, it is desirable to specify metric units, although the equivalent English units are always given in parentheses. It may also be desirable in commercial specifications, especially the heat treatment, to use the metric units of temperature.

If the proposed order is to be construed so strictly as to interfere with the practices mentioned above, it is proposed that it be modified by the addition of the following sentence: "This shall not be construed to prevent the utilization of metric units in research and development work, nor their use in specifications or contracts where such use is in accordance with commercial practices."

Coast Artillery Corps.—No complication would arise in the Coast Artillery in connection with the issuance of the proposed order, provided nothing in the order is construed as eliminating the Artillery mil (0.400—[illegible]) as a unit of angular measure, and provided further that replacement will be done by classes of instruments and not by the issue of a few instruments at a time, graduated in British units as replacements for a like number of similar instruments graduated in the metric system. The latter method would result in a prolonged period of transition, during which there would be in use in the Coast Artillery two systems of graduation on the same instrument. Evidently this method of replacement might result in serious complication.

Quartermaster General's Office.—Purchase and Storage.—Proposed order satisfactory.

Surgeon General's Office.—Proposed order satisfactory.

Construction Division.—(1) The Construction Division does not believe that any complications would arise should an order, worded as in your letter, be published, provided that order is modified as suggested under paragraph (c). This would leave the Army free to conform to existing commercial standards, a condition that is absolutely necessary in order to insure satisfactory contact.

(2) It is suggested that the words "when feasible" be added to the last part of the paragraph, making the last sentence read: "Material and equipment of this nature, when worn out or obsolete, will be replaced by articles graduated in British units when feasible."

WAR DEPARTMENT,
OFFICE OF THE CHIEF OF STAFF,
Washington, May 1, 1926.

Memorandum for The Adjutant General of the Army.
Subject: Map Scales.

1. The Secretary of War directs that the accompanying paper "A. G. O. 661.7 Pub. Div." on the above subject, dated January 2, 1926, from the Cavalry and Infantry board be returned to that board through the Chief of Engineers, United States Army, by indorsement substantially as follows:

The use of the metric system in the Army is prohibited by a recent decision of the War Department, which will shortly be published in orders. The present policy as to the use of the metric system limits its employment on maps of foreign countries in which that system is required and in common use. On such maps both British and metric systems will be shown by adjacent graphic scales with a common origin; this practice appears to meet the recommendation for a graphical conversion table mentioned in paragraph 1, fourth indorsement hereon.

A study of the domestic map situation is now under way, which contemplates the use of the grid system mentioned in paragraph 3, fourth indorsement hereon.

The placing of mil scales on all maps is not approved. This requirement will be better met by the use of a mil protractor and the rectangular coordinates to be placed on military maps.

A. B. COXE,
Colonel, General Staff,
Acting Director of Military Intelligence.

[Prepared by John Paul Jones, captain, Ordnance Department United States Army, and W. C. Hedgcock, captain, Ordnance Department United States Army.]

EXPERIENCE IN THE USE OF THE METRIC SYSTEM.

WAR DEPATMENT,
OFFICE OF THE CHIEF OF ORDNANCE,
ENGINEERING DIVISION,
January 17, 1919.

1. The question of the units of measure to be used on the drawings of designs of French artillery was first raised by Mr. A. B. Whittet, leading draftsman, in connection with the 155-millimeter howitzer carriage, model of 1918 (Schneider), on June 28, 1917. Mr. Whittet called attention to the fact that French drawings used first-angle projection instead of third and many parts were drawn to scales too large to be accommodated on Ordnance office drawings, hence all parts of this carriage had to be redrawn and traced with the usual checking. He also gave it as his opinion that if it were necessary to change from the metric system to the English system of measurement the problem would become more difficult than the design of a new carriage. Considering the fact that a large number of inexperienced draftsmen had to be used on this work he questioned whether the drawings prepared under the above conditions would be serviceable. He also stated that the changing to the exact English equivalent would work a hardship on the manufacturers in that it would demand an accuracy not necessary to the functioning of the piece and that if the nearest English equivalent were used there would be great danger of spoiling the function of the piece and it would undoubtedly do away with interchangeability with similar pieces manufacturered in France. From a manufacturing point of view, Mr. Whittet recommended that the drawings be made using the metric unit, with the exception of bolts, rivets, plates, gears, and the pitch of threads. In summary, he stated that many man weeks could be saved in the drafting room by the adoption of this policy. A copy of this memorandum is herewith inclosed, Exhibit A.

2. In a second memorandum on the same subject dated July 6, 1917, Mr. Whittet qualified his previous statement to some extent and recommended the use of standard Birmingham gauge plates and that gears be left in the metric units. He questioned the advisability of using metric threads on the ground that there might be serious delay in obtaining the necessary cutting tools. However, he pointed out the fact that the change to English threads did not allow interchangeability with French matériel. He also pointed out that an entirely new set of test tools would be necessary in any case, which could be made as rapidly in one system as the other. A copy of this memorandum is herewith inclosed, Exhibit B.

3. The Ordnance Department then (July 7, 1917, CF004.401/7, CF004.401/9) asked the advice of representative tool and gauge manufacturers regarding the advisability of manufacturing the matériel having metric thread and gear systems, and inquired as to the availability of tools for making such work to the metric system. Such concerns as Greenfield Tap & Die Co., Ideal Tool & Machine Co., Jones & Lampson, Brown & Sharpe, and the Geometric Tool Co. all replied to the effect that while the stock supply of metric taps, dies, twist drills, milling cutters, and small tools was more limited than the supply of English tools they were in a position to furnish these tools in the international metric system in all standard sizes and would accept large orders for 60 days' delivery. (See files CF004.401/6, 8, 10, 11, 13, 15, 16, 20, and 21.) Bethlehem Steel Co. and several representative rolling mills were questioned as to the advisability of specifying plates in metric thicknesses. The Ordnance Department received advice that in view of the fact that the quality and tonnage of plates required were such as to demand special rolling there would be no appreciable difference in the time of delivery between plates rolled to metric dimensions and to English dimensions.

4. In view of the foregoing information it was decided to use the metric system throughout, and Ordnance Office drawings for the 155 millimeter howitzer, model of 1918 (Schneider), and 155 millimeter gun, model of 1918 (Filloux), were prepared accordingly. From the point of view of the drafting room this decision probably saved six weeks to two months actual time in the preparation of drawings, because the drawings were exact duplicates of and in many cases traced from the French drawings. This policy also insured the perfect functioning of the carriages and eliminated the possibility of error in the conversion to inches. On the other hand, it may be said that the use of the metric system was responsible for many of the minor errors and inconsistent tolerances which were discovered in the course of production. No tolerances were shown on any of the French drawings, and it was therefore necessary to establish them in accordance with the best judgment of the Ordnance Department. It is believed that not a single draftsman in the carriage division had had previous experience in the use of the metric system. and it was therefore extremely difficult to visualize the meaning of small fractions of a millimeter. The result was, in many cases, tolerances unnecessarily close and in many other cases absurdly wide. These discrepancies were the subject of a great deal of correspondence with manufacturers extending over a period of over a year, and at the present time the tolerances on the above carriages are not logical or satisfactory in all respects.

5. Thread gauges for the metric threads were not commercially available and it was necessary to manufacture these especially for the manufacture and inspection of the parts of these carriages. Later, in February, 1918, it was decided to manufacture in this country the 75-millimeter gun carriage. model of 1897 (French), and by the time the manufacture on that carriage was inaugurated all of the tap, die, and thread gauge manufacturers were working to maximum capacity on the gauges and tools for the 155 millimeter as well as other ordnance matériel.

6. In the manufacture of the 155-millimeter gun and howitzer it was undoubtedly true that some delay was caused by the use of the metric system. Dodge Bros., who manufactured the recoil mechanism for both pieces, refused to adapt their shop to the use of metric units and accepted the responsibility of changing the drawings, with the exception of threads, into the exact English equivalent. In doing this they carried all dimensions not covered by tolerances to three decimal places and dimensions which were covered by tolerances to four places. In general, Dodge Bros. were very successful and delivered recuperators for the 155-millimeter howitzer in great quantities before carriages were available to use them on. They made no attempt to get into production on the recuperator for the 155-millimeter gun until the howitzer project was well under way. The Mosler Safe Co. and Osgood Bradley Car Co., who manufactured the 155-millimeter howitzer carriage, and the Minneapolis Steel & Machinery Co., who manufactured the 155-millimeter gun carriage, elected to use the ordnance office drawings without change. They were, however, authorized to use commercial sizes of hexagon bar stock in their turret machines and commercial split pins, etc. All of these companies experienced a great deal of trouble in securing taps, dies, twist drills, milling cutters, and small tools. Some trouble was also experienced in securing metric micrometers and thread gauges. In general the deliveries on these tools were two or three months behind the dates promised. It can not be said, however, that these difficulties actually delayed delivery of carriages to any appreciable degree, for it was necessary for all of the manufacturers to do such a tremendous amount of preliminary work in the erection of buildings, installation of machine tools, etc., that the small tools were on hand by the time they were ready to use them. Small screw machine parts which were sublet to outside concerns were not available at the time the first carriages were ready for assembly. It was therefore necessary to make a limited number of these small parts on lathes. In the case of the 155-millimeter howitzer carriage, when the screw machine parts were delivered it was found that they did not pass inspection gauges furnished by the Ordnance Department. This resulted from a misunderstanding as to the type of thread required and was not considered serious in view of the fact that the parts were interchangeable among themselves and were therefore accepted.

7. When the manufacture of the 75-millimeter gun carriage, model of 1897 (French), was decided upon February 8, 1918, the practice adopted in the preparation of drawings for the 155-millimeter matériel was followed for the same reasons as those previously considered. The ordnance office drawings *were all exact reproductions* of the French drawings and the metric dimensions

on the latter were duplicated exactly. As in the case of the 155-millimeter matériel, the French drawings of the 75-millimeter matériel did not, with few exceptions, show any tolerances. Tolerances were, therefore, prescribed by the ordnance office in the same manner as that previously followed on drawings dimensioned in the metric system with the same results, i. e., in many cases being absurdly close or absurdly wide. It had been decided as essential that the component parts of the 75-millimeter gun carriage, model of 1897 (French), as manufactured in this country be interchangeable with similar parts manufactured in France, and it was believed that this was insured by working to the same metric dimensions as used by the French.

8. To retain interchangeability it was necessary that identically the same screw threads be used as used in France. In the case of the 75-millimeter carriage the threads were not all of international metric system, but were principally special V threads of six different profiles. The characteristics of these special threads had been previously unknown in this country, and great difficulty was experienced in obtaining information as to their form and dimensions from France. Although it had been decided February 8, 1918, to build the French 75-millimeter carriage and drawings were issued February 11, it was not until April 5 that enough information was at hand to clearly show and dimension the threads on the drawings. Even this information was later found partly erroneous, with the result that absolute interchangeability was not eventually secured.

9. The orders for recoil mechanisms for the 75-millimeter French carriage were placed with Rock Island Arsenal and the Singer Manufacturing Co. On February 21, 1918, Rock Island Arsenal wrote (EF 473.824 (230)/50) to this effect:

"It is very important that the type of thread to be used on the Puteaux cylinder be determined at an early date, in order that the necessary arrangements may be made for cutting these threads on the cradle at this arsenal. At present the lead screws, etc., for all the machines at this establishment have been purchased for the English system. This matter is brought to your attention, as considerable expense may be involved in changing these over to the metric."

As the metric threads were retained, Rock Island Arsenal provided metric lead screws for their machines, but it is not believed that this particularly delayed any work, as it was some time before all detailed thread information was available for them.

10. Rock Island Arsenal wrote, April 15, 1918 (EF 400.114/1095), that considerable difficulty was being encountered in the shops in regard to the use of metric dimensions on drawings, and requested that the English measurements be put on the drawings. It was stated that, at an establishment of the size of the arsenal, which had been working almost entirely under the English system, that great confusion was caused in working on a comparatively small number of articles under the metric system, and that it was impracticable at that time to secure the necessary metric measuring tools. Instructions had therefore been given to change all dimensions on drawings which were put into work at the arsenal from metric to English dimensions. The belief was expressed that if the metric system was followed considerable confusion would result, and it was suggested that the drawings be made to show the English dimensions as well as the metric. (See inclosure, Exhibit C.) The drawings of the recoil mechanism were changed, as a result of the foregoing, to show English equivalent dimensions in addition to the metric dimensions, and Rock Island Arsenal and Singer Manufacturing Co. used the English dimension in manufacturing the mechanisms.

11. The drawings of the 75-millimeter French carriage (exclusive of recoil mechanism) and the sight therefor were maintained in the metric system and the English equivalent dimensions were never shown on the Ordnance Department drawings. However, the Willys-Overland Co., who manufactured the carriages, elected to use the English system in their shop and prepared master prints from the Ordnance Department prints, substituting English dimensions for the metric. Their shop prints were then made from the master prints. The same practice was followed by the sight manufacturers. It is apparent that, in this way, no time was saved by preparing the original drawings in the metric system, but, on the other hand, the drawings were completely dimensioned twice, first in the metric system and then in the English system. One advantage experienced in converting the metric to English dimensions was that a number of errors and inconsistencies in the French dimensions were found.

In all of the conversions into English dimensions the exact equivalents were used, there being no attempt to use nearest, even English dimensions.

12. The Willys-Overland Co. found great difficulty in obtaining metric size rivets, driven pins, and split pins. They were accordingly authorized March 11, 1918 (EF 473,13(559)/2) to drill the rivet holes to the metric size but to use the nearest size standard American rivets which would properly fill the holes. The company was also allowed to use standard American size split pins and driven pins. It was also found that production of gears would be greatly delayed if the French tooth forms were insisted upon, on account of lack of available tools to cut them. The use of involute teeth having pressure angles of 14½ and 17½° was therefore allowed, it being found that they could be made to interchange with the French gears. Probably the greatest handicap experienced in the production of the French 75-millimeter carriages was the special French threads. All taps, dies, and thread gauges had to be specially made, and, with the tap manufacturers crowded with other work, several months delay was occasioned in obtaining them. This should not be considered as a disadvantage particularly peculiar to the metric system, as the threads were special and not metric standard. However, it is believed true that if American standard threads had been used, much time would have been saved over the use of either metric standard or metric special threads.

13. The great difficulty in the use of the metric system appears to be the inability to think in metric dimensions by the average man used to working to the English system. In using metric dimension he first must mentally or graphically convert them to the English dimensions with which he is familiar. It does not appear to make so much difference whether the English conversion becomes even units or not, for this purpose, as long as the dimension can be visualized and means something to him. This has appeared to be true whether in the drawing room or the shop. A further difficulty in the shop is the lack of commercially available metric tools, measuring instruments, rivets, bolts, pins, etc. It is believed, therefore, that under present existing conditions and until the workman is educated to think in the metric system and can be commercially provided with the necessary tools and measures, that quicker production will be obtained with work done in the English system. This is thought true whether the dimensions are in irregular fractions due to exact conversion from metric dimensions or whether they are in regular English commercial units and fractions, although the latter case is obviously more desirable from a production standpoint. Where it is necessary to reproduce a design previously made in the metric system, and to maintain interchangeability therewith, it is thought that time spent making conversions in the drawing room will, as a rule, be saved several times over in the shop. If interchangeability with metric design can be sacrified, much further time and money will be saved in the shop by converting into regular English units and fractions, using United States standard threads and commercial sizes of plates, bolts, rivets, pins, etc. For new designs, it is believed that, under present conditions, the metric system is beyond consideration.

14. Where necessary to follow metric designs and to convert them into English measure, great care should be exercised in using conversion tables for this work. Some of them appearing in handbooks are unreliable, and they should be carefully verified. The metric conversion tables appearing in the Machinery handbook have, for example, been found full of errors.

Exhibit A.

Memorandum on 155 millimeter howitzer carriage drawings (Schneider).
Subject: Units of measurement for Ordnance Office drawings.

1. A question of policy should be decided before starting a large force of draftsmen on the work of copying the Schneider drawings for the Ordnance Office set. The question is whether the dimensions should be converted into inches on the new drawings or copied in the metric system, excepting such as apply to screws, bolts, rivets, steel and brass plates, gears, pitch of thread, etc.

2. The details are drawn in first angle projection, so that the views must be rearranged to suit the O. O. system; many parts are drawn to such a scale that they would not fit O. O. standard tracings; many of their drawings are larger than our standard size, consequently in general it will not be to save time by tracing from their prints, hence nearly all the details drawn, checked, traced, and the tracings checked. It is a big job just

to do the drafting, but if in addition to this, the dimensions must be converted, it is going to be a hard one as well, even more difficult than a new design would be to handle. The personal equation will enter into the job to such a large extent, especially if 20 or 25 men go to work on it that it is hard to say that the carriage drawings will be good working drawings to follow when we get through. And there are so many drawings that a few men can not do the drafting work in a reasonably short time.

3. As for the manufacturing difficulties that are involved it seems that if the parts enumerated in paragraph 1 are made according to United States practice, and dimensioned in United States units, and all other dimensions are left in the metric system units, no trouble should arise from using metric scales and micrometers. In general new jigs and fixtures must be designed for this work, and these as well as automatic tools can be planned in the metric system primarily, with more ease and speed than if they were being planned for working to the same sizes, but in the inches units, since no metric measurement has an absolute equivalent in inches. In fact, to make a cut to 10 millimeters with a ±5 millimeters tolerance would be very ordinary, coarse work, whereas to get the same results expressed in inches, i. e., 0.394±0.0197, would really require fine workmanship, and this is only one phase of the question. The example illustrates how laborious it can become to express the size of a part in thousandths of an inch when desiring to convey to the machinist that the work is rough.

4. Test tools must be gotten out for the American work, and since they must be of new design it seems that they can be made simpler by adhering to the metric dimensions on the parts tested. That is "go" and "not go" gauges need not have such fine dimensions when expressed in millimeters as when expressed in inches. Many special tests must be made that do not involve the measurement of a part so accurately, but the test of the functioning or assembly of the parts. Micrometers and gauges for metric measurements should not be difficult to obtain in America, or they could probably be obtained from abroad if necessary in less time than the units can be changed on drawings. It is understood that a considerable number of American manufacturers have had experience in manufacturing foreign material to metric measurements and have experienced no difficulty.

5. Since the Gun Division and the Inspection Division are concerned in this problem, and in order to coordinate the drawings of the Ordnance Office, comment from everyone might be awaited, but if the Field Artillery subdivision starts work on the 155-millimeter howitzer carriage right away without thrashing out the question with the others, work and time may be lost. It seems that a memorandum or order should be issued covering the practice to be followed in making Ordnance Office drawings of material designed in the metric system, and the following points should be covered in so far as the drafting room is concerned: Dimensions, finishes, tolerances, test tools, interchangeability of units manufactured from the converted drawings with those from foreign drawings, bolts, screws, and threads, gears, plates, and structural shapes.

6. To summarize the situation so far as drawings are concerned, it will be better to copy the drawings, using the metric units for the dimensions, than to convert them into exact inch equivalents therefor, or to attempt to change them to the nearest figures that are aliquoit parts of an inch and thereby take the risk of spoiling the functioning of parts. It will enable the office to get a set of working drawings many men-weeks sooner.

A. B. WHITTET,
Draftsman, Ordnance Office.

JUNE 28, 1918.

EXHIBIT B.

Memorandum No. 2 on 155 mm. howitzer carriage and limber (Schneider):

1. Referring to the work of making Ordnance office drawings of the carriage and other details from the Schneider prints, and the unit of measurement to be adopted thereon, the data herewith shows that the metric units can be used for certain parts, and others should be inches.

2. The steel plates can be gotten to the nearest gauge dimension which is rolled regularly, and dimensioned on Ordnance office drawings in milimeters with the

inch equivalent in parentheses, so that it will be known what the drawings are based on. Carnegie Steel Co.'s "Shape Book" has a note in it stating that they roll plates to the Birmingham wire gauge unless otherwise specified. The thickness of the sizes is given in three decimal places, which is more convenient than the United States standard plate gauges would be for conversion to millimeter dimensions. Using American plate thickness will necessitate some extra detailing in connection with the trail plates where several thicknesses come together, and on the Schneider drawings such parts are detailed assembled without the dimensions being separated for each individual part. The changing of the necessary dimensions to make drawings check when the plates are of B. W. S. thickness will require some care in the cradle and the limber structure, but such unimportant parts as boxes and chests, shoulder guards, etc., the change of dimensions need not cause any delay in drafting room.

3. For the gears and worm and wheel it will be best to keep the metric system and specify the gears as on the Schneider drawings: Brown & Sharpe list cutters which will apply to the gears on the Schneider drawings. The worm and wheel are in the Hindley system and therefore the metric dimensions can be as readily used as the inch dimensions.

4. Referring to threads for bolts and screws and parts which are screwed together there is a doubt as to the advisability of using the metric system, due to the number of tools which a manufacturer would have to procure. On the other hand, the parts would not be interchangeable with those of European manufacture if the United States threads are specified. It would be well to use one system or the other throughout the matériel. To use the American system for traversing screw, which has a lead of 4 millimeters as on Schneider drawings equals 0.1575 inch, being 1/.1575 equals 6.34 threads per inch, results in an inconvenient screw to cut. If this particular screw is changed to 6 per inch, the speed of traversing would be changed: 6/6.34 equals 0.94, and 0.94 by 250 equals 235 turns to traverse 6°, an advantageous gain in a mechanism which is so slow. Besides the number of manufacturing tools required for metric screws, this office would require new thread plugs and rings for testing all the parts for interchangeablity, and there are about 80 different sizes in the carriage and limber. If we change to the United States standard threads we may be able to eliminate some of the sizes in the smaller bolts and screws, but it is very probable that an entirely new set of test tools will have to be drawn to suit this carriage.

5. If a set of gauges from France is obtained, then there will be no question of interchangeability between parts manufactured here and in France; in case the gauges can be had the drawings should not be changed in any respect as far as dimensions are concerned, except as to plate thickness, but even the important plates can be rolled to the metric gauges by special request.

6. Referring to the attached prints from pages of Brown & Sharpe catalogue No. 26, the metric gear cutters are explained in full.

WHITTET.

JULY 6, 1917.

EXHIBIT C.

ROCK ISLAND ARSENAL,
Rock Island, Ill., April 15, 1918.

From: The commanding officer.
To: Office Chief of Ordnance, Engineering Bureau, mobile gun-carriage section.
Subject: Metric and English dimension on drawings.

1. Considerable difficulty is already experienced in the shops in regard to the use of metric dimensions on drawings furnished by your office. It is requested, where absolutely necessary, that metric dimensions be given, that the English measurements also be put on the drawings for the convenience of all concerned. It will be appreciated that at an establishment of this size, which is at present working almost entirely under the English system, great confusion is caused if necessary to work on a comparatively small number of articles under the metric system. Furthermore, it is impracticable at this time to secure the necessary metric measuring tools for workmen at this arsenal. Instructions have been given to change all dimensions on drawings which are put into work at this arsenal from metric to English dimensions, and marked prints for revision will be forwarded to your office.

2. It is believed that if the present system in using the metric system is followed considerable confusion is bound to result. For example, drawing 2-97-12 shows the cradle for the French 75-millimeter carriage, model 1897. This part is detailed in the metric system on this drawing. Drawing 2-47-49, covering the forging for the above part, is in the English system, which requires that any shop doing machine operations must make a careful check of the forging drawing and the finished drawing in order to be certain that the forging is of ample size and the methods of machining fit in with the finished forging.

3. It is also noted that in detailing the fuse box the metric system is used. and the fuse box is applied to the 3-inch caisson, model 1916, which is detailed in accordance with the English system. Some drawings issued recently by your office carry a straight metric measurement, while others carry both the English and metric measurements. It is suggested that the latter method be followed on all future drawings furnished this arsenal. In addition to the above it is found to be difficult to secure raw materials of the proper dimensions called for under the metric system. It is believed that very few of these, such as rivets, have been manufactured in this country to metric dimensions. It is hoped that your office will appreciate the difficulties which may be caused by the confusion of the two systems and that in the future all straight dimensions be given in English denominations. If absolutely necessary to retain threads and metric pitch, leads, etc., this arsenal will endeavor to make threads accordingly, but will appreciate it very much if they could be made according to the United States standards.

L. T. HILLMAN,
Colonel, Ordnance Department, National Army,
Commanding.

[First indorsement.]

ORDNANCE OFFICE.
MOBILE GUN CARRIAGE SECTION,
ENGINEERING BUREAU,
April 19, 1918.

To the COMMANDING OFFICER,
Rock Island Arsenal:

1. The question of using metric and English dimensions on drawings has been given very serious consideration by this office, and no really satisfactory solution of the matter has been arrived at. It is, of course, very desirable to maintain the exact dimensions, tolerances, etc., prescribed on the French drawings, and in order to effect this as far as possible the metric system was retained, with the hope that manufacturers would by degrees be able to work in the metric system. Addition of the English dimensions to the English drawings renders the drawings very congested, and they will probably be found confusing. This office, however, proposes now to place both dimensions on the drawings, and this work has been started in this office. In the meantime, it will be necessary for arsenals and manufacturers to work to the metric dimensions, and, if necessary, place the alternate English dimensions on prints used in the shops.

By order of the Acting Chief of Ordnance.

T. L. COLES,
Lieutenant Colonel, Ordnance Department, National Army.
By J. B. ROSE,
Lieutenant Colonel, Ordnance Department, National Army.

[Second indorsement.]

ROCK ISLAND ARSENAL, ILL.,
May 2, 1918.

To ENGINEERING BUREAU,
Mobile Gun Carriage Section:

1. Noted and returned to his office for filing purposes. The action taken by his office it is believed will eliminate the difficulties now being experienced in handling drawings carrying only metric dimensions.

L. T. HILLMAN,
Colonel, Ordnance Department, National Army, Commanding.
By L. C. VAN BEVER,
Captain, Ordnance Department, R. C., Administrative Officer.

Mr. CROCKER. Mr. Chairman, could I ask the Colonel a question?

The CHAIRMAN. Yes; you may.

Mr. CROCKER. The chairman asked you whether the War Department as a whole was against this bill, and whether or not they had gone into it thoroughly. As I understood your answer, they had not gone into the matter to the bottom of the roots, so to speak. All of the departments did not have time to submit an opinion, did they? I did not get that quite clear.

Col. TSCHAPPAT. No; all the departments have submitted opinions except the Chemical Warfare Service.

Mr. CROCKER. I imagine that some of the men have not had an opportunity to read over this bill, S. 2267, and to ascertain that it does not in any way affect manufacturing. It is just for the commercial use of the system in this country. I take it, from your report, that the War Department would be opposed to a bill which would affect manufacturing.

Col. TSCHAPPAT. It would be extremely difficult to separate the two, I should imagine. I should suppose that if the commercial use of this system should be made compulsory, that manufacturing would have to follow.

Mr. CROCKER. That is, that it would be necessary for it to follow?

Col. TSCHAPPAT. Yes.

Mr. CROCKER. What I am trying to bring out is that the War Department would not oppose a complete change. But, considering that this particular bill does not pertain to the manufacturing end, could you say that the War Department would be against the commercial use of the metric system in this country? Senator Ladd, the author of the bill, is out of the city, and I know he would be interested to know what the War Department's attitude is on his bill. In view of the fact that you stated the War Department is against the metric system if it is introduced in blanket form, I was just wondering whether or not the different chiefs of divisions had an opinion that the metric system was going to be used exclusively in this country or if they understood that the metric system was only to be used commercially. Wherever the sale of products was made, in other words, things would be sold by metric weights and measures, but the machine shops and the methods of production would in no way be affected by this present bill.

Col. TSCHAPPAT. I think they understood the wording of the bill to mean that it referred only to commercial transactions, but I think they also understood that it would be impracticable to use one sort of measurement in the machine shop and another sort of measurement commercially.

Mr. CROCKER. There is another question that I would like to ask as to the use of the metric system in France. Do you have any information to the effect that the men in France were mentally equipped to understand the metric system and use it with little difficulty over there?

Col. TSCHAPPAT. There was not much difficulty connected with the use of the metric system, particularly with the use of the metric system in maps and on range scales of guns. There was very little difficulty.

Mr. CROCKER. It is the understanding that Gen. Pershing came back from France in favor of the adoption of the metric system here. As I understand it, on coming back here he issued a letter intimating that he was in favor of the adoption of the metric system in this country in the best way for all concerned.

Those are all the questions I had to ask.

The CHAIRMAN. Very well. Have you anything further to put in the record, Colonel?

Col. TSCHAPPAT. That is all I have.

The CHAIRMAN. I thank you for your attendance and for the valuable information you have given the committee. We will stand adjourned until 11 o'clock to-morrow morning.

(Whereupon, at 11.55 o'clock a. m., the subcommittee adjourned until to-morrow, Thursday, October 27, 1921, at 11 o'clock a. m.)

THE METRIC SYSTEM.

THURSDAY, OCTOBER 27, 1921.

UNITED STATES SENATE,
SUBCOMMITTEE OF THE COMMITTEE ON MANUFACTURES,
Washington, D. C.

The subcommittee met, pursuant to the adjournment of yesterday, at 11 o'clock a. m., Senator Charles L. McNary presiding.

STATEMENT OF DR. H. W. WILEY, WASHINGTON, D. C.

The CHAIRMAN. Dr. Wiley, I understand you are with us to-day to give your views concerning the metric system, with particular reference to the bill now pending in the Senate, which has been referred to the Committee on Manufactures, and which this subcommittee is considering. You have had considerable experience in hearings, so just go ahead in your own way and let us hear what you have to say.

Dr. WILEY. My name is H. W. Wiley. Formerly for 30 years I was Chief of the Bureau of Chemistry; am now a farmer and editor, interested practically and scientifically in this bill.

In 1886 Congress legalized the so-called metric system. I say "so-called metric system," because all systems of weights and measures are metric, but metric here means decimal. The original Congress of the United States adopted the decimal system for our money, and it has been found workable, convenient, easy to learn, so that even a child can make change in the decimal system, which would be difficult if the English system—and we have inherited all our other weights and measures from the English—were in vogue.

Reasoning by analogy, therefore, in the comparative value of these two systems of money, the decimal system would be a great boon to the country for all weights and measures. I am aware that very learned men, many of them, prefer the duodecimal, or twelve, system, and it has its uses. Also especially it has its uses in the measuring of a circle, as the division of a circle into 360 degrees is a very convenient method, but a circle could be divided decimally with just as great ease, so that no damage would come from that.

In 1873 I read a paper before the Association for the Advancement of Science at the Portland, Me., meeting, advocating the introduction of the metric system into medicine. I believe that was the first paper ever presented of a scientific character to an American audience on this subject. The thesis which was laid down there was more speedily enacted into law than I had any anticipation of at the time. In 1894 the Congress passed a law requiring that in the medical services of the United States the metric system should be solely employed and gave one year for the change. It went into effect on the 1st day of January, 1895, since which date no transaction in medicine, no prescription has been written except in the metric system. It apparently caused no disorder or confusion and could not possibly do so because of its extreme simplicity.

Senator, I just want you to look at these tables [indicating] of the old system and the characters which are used in medicine. You see how nearly alike the ounce and the scruple are. The greatest confusions have arisen in the old system, and the present one is still followed by some physicians in writing prescriptions in this old system, whereas in the metric system, shown above, there can be no possible confusion.

So impressed was the pharmaceutical profession of this country with the extreme simplicity and value of the metric system in medicine, as enacted by

Congress and enforced in the Army, the Navy, and the Public Health Service by the physician, that early steps were taken to change the Pharmacopœia in such a way as to make the metric system the sole recommended or official system.

The CHAIRMAN. For use in pharmacy?

Dr. WILEY. For use in pharmacy. I was president of the pharmacopœial convention of the United States during this ninth annual revision of the Pharmacopœia. My term of office lasted from 1910 to 1920, in which this book was issued. That book contains this phrase. Let me just read it to you, Senator, in regard to weights and measures, appearing on page 49 of the introduction:

"Weights and measures—Metric weights and measures: The metric system of weights and measures is the only one recognized in the formulas of this Pharmacopœia."

But for the convenience of the old pharmacists it was ordered that the equivalents in the old system should be published in this edition, at least, so that the dosage is given in the metric system, and then, in parentheses, the equivalent in the old system. That shows that in the pharmaceutical profession the system is now entirely recognized and adopted.

The CHAIRMAN. So this bill, if passed, would not add anything to the uses you make now of the metric system?

Dr. WILEY. Nothing at all. It has already been voluntarily adopted by the great convention which made the Pharmacopœia. Every pharmacist knows the metric system thoroughly, and thousands of prescriptions of physicians outside of the Army and Navy are now written in the metric system.

The CHAIRMAN. Is it true this example would fit into many other professions that wanted voluntarily to take the system and apply it?

Dr. WILEY. The scientific world has already adopted it, and the manufacturing world is coming to it much more rapidly now. There are additions every day of manufacturers who are using this system either alternately or primarily with the old system as the alternate. So that perhaps even without action of Congress, in the course of 50 or 100 years this system, which commends itself so thoroughly by its simplicity, might come into common use. But there are many reasons, Senator, why it is important that Congress should further this introduction by the legislation which is asked for or some similar legislation.

I want this morning to emphasize particularly two things. I do not care to go over the general evidence which has, I think, been fully presented.

The CHAIRMAN. Yes; over and over again.

Dr. WILEY. But I want to emphasize just two features this morning. One is to relieve the burden of our children in the public schools. Two years ago I applied to the assistant superintendent of schools in this city, Mr. Kramer, who was a product of our schools, born here and educated here and knows them thoroughly, for information as to how much of the time of the boys and girls was taken up in an attempt to learn the ordinary system of weights and measures as enacted by Congress for this District. I do not think they go outside and try to do anything else than that.

He sent me a published catalogue of the studies in the primary schools for the eight years before entering the high school, and he marked with his pencil those studies in which these denominate numbers entered and which the boy or girl had to learn. I was surprised to learn that in the first grade they began, and in every one of the remaining seven grades the work is increased up to the sixth year in which it reaches a maximum, and then is not quite so time consuming after that in the remaining two years. It is also continued in the high school, and naturally that gives 12 years of the school life of the boy and girl in which he or she is learning or trying to learn this system.

To show the complication of this system I brought along this book [indicating]. It may have been shown to you before. It is issued by the Bureau of Standards, containing the weights and measures laws of the various States. It does not contain any municipal enactments, but just of the States, and it embraces 564 pages of reasonably fine print.

If the boy or girl does learn the tables of weights and measures, and he goes into Maryland, or Virginia, or Oregon, he is met with a new set and a new scheme, and his labor as far as practical purposes is concerned has been wasted. And more than that it is impossible, I believe for any ordinary human memory to say he knows all the weights and measures in this book. Some of them are the same in all of the States; but in nearly every State there are differences. So that the problem presented to the student, the young child, is overwhelmingly burdensome.

I would undertake to teach an ordinarily intelligent boy or girl of 10—a girl can learn it quicker than a boy, as a rule—in 15 minutes the fundamental principles and all the names to be remembered in the metric system. There are only nine. There are three measures, three multiples, and three decimals, making nine altogether; and the multiples and the decimals are the same name. The only changes are the differences in the names of the three standards—the meter, the gram, and the liter. They are all so intimately corelated and related that when you know one of them you can readily figure the others—for instance, the meter—all the rest are based on the meter.

There is no use to my mind to discuss the problem that the meter is not what it claims to be. Suppose it is not. I do not suppose it is possible that anybody should accurately measure the one ten-millionth of the earth's quadrant from any point on the Equator to the pole. That is assumed to be the meter, and it is approximately correct. That is, it is a natural division, as nearly as human ingenuity can make it. But suppose it is not exactly one ten-millionth. It makes no difference as regards the accuracy and usefulness of the system. It has been adopted by the nations of the earth, the standard meter is deposited in Paris under the guardianship of the world, and all other meters, all other derivatives of weights can be referred at any time to the standard meter. It is made of indestructible material; it is made of material that changes the least with changes in temperature. And when it is used it is kept at a standard temperature always, so that there can be no difference in its length due to temperature. But from this initial measure, presumably one ten-millionth of the earth's quadrant, all the other values are derived.

In looking over our system I find only one which is derived in any way from another, and that is the imperial gallon of England. The imperial gallon of England is a volume occupied by 10 pounds of pure water at the standard temperature of its greatest density, which is about 37° F. or about 3.9° C. As water approaches the freezing point it begins to expand, and therefore at that temperature water has its smallest volume, and that is taken as the volume of the imperial gallon.

The liter is made in the same way as the meter. It is the volume occupied by the cube of 10 centimeters and the volume of water that occupies that cube is called the liter. That volume of water weighs exactly one kilogram at the standard temperature of greatest density.

Thus all the units of the metric system are derived from that one unit of length.

The mutiples are Greek terms. They are deka, hecto, and kilo. That is just a tour de force of memory, for children do not need to be Greek scholars. Deka means 10 times, hecto means 100 times, and kilo means 1,000 times. Of course, there is the myria also, but that is rarely used. These three are sufficient.

The fractions of these units are taken from the Latin language, and for the same reason as I said before, it is not necessary that the child should know Latin. Deci means a tenth, centi means a hundredth, and milli means a thousandth.

Those are nine words to remember and then you know the whole system and can express any fraction of it in any way with absolute accuracy. Hence it commends itself by its simplicity.

The CHAIRMAN. You have got only six words.

Dr. WILEY. The three names of the units are the other three, the meter, the gram, and the liter. Those are the other three.

The CHAIRMAN. I wanted the record to show that clearly.

Dr. WILEY. The divisions are three above and three below. So it makes nine words altogether to memorize and you have the whole system. Every teacher that I have spoken to about it would welcome, more than welcome, with enthusiasm this new system.

The CHAIRMAN. You have discussed the matter from an education standpoint, with which I have great sympathy. But that is not the bill. You are going upon the proposition that it would be well, indeed, for the common schools to teach this system to the young.

Dr. WILEY. Yes.

The CHAIRMAN. This bill is not for that purpose. It is to thrust it, willingly or unwillingly, upon the people generally of the country, irrespective of whether in school or out of school, what their occupation in life, their age or education. The States could adopt it, or a great organized movement could bring about a uniformity of action by the State legislatures requiring the system to be

taught in the public schools. I think that is one very practical way of taking it up and starting in with the young, teaching it in the schools. That is a theory, perhaps, on which we could meet on common ground. But that is not this proposed legislation. Do you prefer that method to this one? Would you prefer the educational method rather than the arbitary legislation method?

Dr. WILEY. I would like the arbitrary legislation in connection with its use in our educational system.

The CHAIRMAN. This bill does not do that at all. This bill has no reference, as I read it, to educational features at all.

Dr. WILEY. No, sir; but if the metric system is adopted then the educational system must necessarily follow. Senator, if I teach my boys the metric system at home, the moment they go to the grocery store it is of no use to them. They have got to learn what a pound is and an ounce and a gallon, if there was any such thing as a definite idea of gallon. But I am coming to that point right now.

The CHAIRMAN. Very well.

Dr. WILEY. That is just one feature that I want to emphasize. I was very much struck, Senator, with a remark you made when I was here before, and in your opinion the farmer would be burdened by the change, and I want to say just this——

The CHAIRMAN. I do not know that I used the word "burdened" or a kindred word. I asked the witness repeatedly what advantage it would be to the farmer. Put it that way.

Dr. WILEY. Perhaps that is the better way to put it.

The CHAIRMAN. Yes.

Dr. WILEY. I consider the farmer, of all business men, would be best served by this bill. There is no other business where the confusion in the terms is so great as in what the farmer produces and in what the farmer buys. The idea of what a barrel is, or a bushel or a box, is so vague, so uncertain, and so fugitive that a farmer in one State can not have any idea of anything more than in his own State, what it is. The moment he goes into another State he finds a different value placed upon it. So there is the utmost confusion. There is not a farmer in my part of the State who buys a ton of coal that knows how much he gets.

The CHAIRMAN. That coal illustration has been used repeatedly, as to the long and short ton. I think that is the only article that is brought forth here as being susceptible of fraud. I am amazed at the ignorance of the man who would stand idly by and accept 2,000 pounds for a long ton of 2,240 pounds. If we have scoundrels around of that kind they ought to be prosecuted.

Dr. WILEY. If it had not been for the act of Congress that would now be going on here. Before Congress fixed a ton of coal at 2,240 pounds, we had instances here of where the short ton was served.

The CHAIRMAN. That refers to the item of coal. Is there any other item?

Dr. WILEY. Yes; I have them all here, and I would like to submit them.

The CHAIRMAN. Very well, I will be glad to have you do it.

Dr. WILEY. I submit for the record a table showing the hopeless confusion of the weights and measures under our present system as it confronts the farmer:

Variation of weight per bushel of various products of the farm or products purchased by the farmers in different States.

State.	Article.	Weight per bushel.	State.	Article.	Weight per bushel.
		Pounds.			*Pounds.*
Nebraska	Plastering hair	8	Kansas	Malt	32
Maine	do	11	Montana	do	30
Nebraska	Hempseed	44	Virginia	Oats	30
Nevada	do	48	Oregon	do	32
Minnesota	do	50	Arkansas	Onions	57
North Dakota	Flaxseed	56	Connecticut	do	52
New York	do	55	Florida	do	56
Iowa	Hungarian grass seed	50	Indiana	do	48
Minnesota	do	48	Michigan	do	54
7 States	Lime	80	Ohio	do	55
8 States	do	70	Pennsylvania	do	50
Indiana	Malt	35	Oklahoma	Peaches	48
Illinois	do	38	Texas	do	50

Variation of weight per bushel of various products of the farm or products purchased by the farmers in different States—Continued.

State.	Article.	Weight per bushel.	State.	Article.	Weight per bushel.
		Pounds.			*Pounds.*
Florida	Peaches	54	Texas	Corn unhusked	73
Oregon	Pears	45	Arkansas	Corn meal	48
Tennessee	do	56	Colorado	do	50
Georgia	do	60	Oregon	Oats	32
Ohio	Popcorn	42	New Jersey	do	38
Indiana	do	56	Oregon	Dried peaches	20
Iowa	do	70	Alabama	do	38
Pennsylvania	Potatoes	56	Arkansas	do	33
Oregon	do	60	Kentucky	do	39
Georgia	Sweet potatoes	55	Tennessee	do	26
Arkansas	do	50	Virginia	do	40
Connecticut	do	54	Arkansas	Salt	50
Iowa	do	46	Colorado	do	80
Illinois	Corn	56	Florida	do	60
Pennsylvania	do	58	Michigan	do	56
Iowa	do	50	Vermont	do	70
Arizona	do	54	Iowa	Tomatoes	50
Ohio	Corn in the ear	68	Kansas	do	56
Mississippi	do	72	Maryland	do	60
Indiana	do	[1] 68	Missouri	do	45
Arkansas	Corn unhusked	74	Alabama	Turnips	55
Alabama	do	75	Arkansas	do	57
Florida	do	70	Florida	do	54
Iowa	do	75	Kentucky	do	60
Oklahoma	do	72	Michigan	do	58
Tennessee	do	74	Wisconsin	do	42

[1] 70 pounds per bushel after Dec. 1.

A bushel of charcoal in Connecticut equals 2,748 cubic inches.

A bushel of charcoal in Colorado equals 2,500 cubic inches.

A bushel of charcoal in Pennsylvania equals 2,571 cubic inches.

A bushel of lime in Pennsylvania equals 2,150.42 cubic inches.

A bushel of coke in Pennsylvania equals 2,648 cubic inches.

A bushel of coke in Missouri equals 2,648 cubic inches.

A bushel of charcoal in Vermont equals 1¾ pecks.

A bushel of lime in Vermont equals 1¾ **pecks.**

A bushel of ashes in Vermont equals 1¾ **pecks.**

In some States a bushel is required to be a heaped measure, while in other States it is required to be struck measure. In Michigan it is provided by law that half bushels and parts thereof shall be the standard measure for charcoal and prunes and other commodities commonly sold by heaped measure, and shall be heaped as high as may be without special effort or design. And a similar provision is made in other States that it shall be heaped in this way or that way.

A bushel that is heaped holds twice as much as a half bushel that is heaped, on account of the difference in base and circumference; while the quart has still a smaller weight when heaped. So there is no guaranty at all in such a measure as that as to how much you are going to get for a bushel.

In Connecticut the heaped bushel is defined as 2,564 cubic inches. That is definite, but you could not do it by heaping—you never could measure that amount by heaping it. In some States a ton of coal is fixed at 2,000 pounds and in others at 2,240 pounds. There is another page which I should have read with the other. It is the one I took out first. I went through these State laws to get this.

If I brought to your notice what the barrel weights are in the different States, and the hogshead, articles in which farmers deal constantly, you would see that they have no set value in this country. But, more than that, under the Constitution I doubt whether the States can legally fix standard weights, because the first article of the Constitution, section 8, provides that the Congress shall coin money. The States can not do that. Also to fix the value of foreign coins and establish standards of weights and measures.

The only standard that Congress has ever established is the metric system. The Congress of the United States never has approved of these measures. They have said to the Secretary of the Treasury, "You may fix standards," and the

standard pound of the United States, and the standard yard, etc., are fixed, not by Congress, as the Constitution requires, but by the Secretary of the Treasury. The only standard that Congress has ever legalized is by the act of 1866 in legalizing the metric system of weights and measures.

The CHAIRMAN. Doctor, that table you have given us is very interesting, but I think we were all conscious of the existence of those variations. They are violent variations and unfortunately they do exist in connection with agricultural products in different States. You have given illustrations of them. I want to know if, in a practical way, it interferes with commerce between the States in the selling of the products. I understood you to call attention to the fact that as to pears in Oregon the bushel was 45 pounds and in Tennessee it was 65 pounds. You don't mean to infer that the commission merchant in Chicago would pay as much for the 45 pounds as he would for the 65 pounds, do you?

Dr. WILEY. No; but he would sell 45 for as much as he would 65 if he had half a chance?

The CHAIRMAN. If we are going to assume that everyone in business is crooked, we will have to make a lot of new laws.

Dr. WILEY. A man's conscience may be perfectly clear legally in selling by the bushel that is legal in the place where he is. But suppose peaches were produced in Tennessee and carried to Oregon. Would they sell to the Oregon merchant the 65 pounds that they bought in Tennessee for a bushel? No; they would sell 45 pounds to an inhabitant of your State.

The CHAIRMAN. I take the view, of course, that the public uses some discretion and sense in buying, and that there is some honesty in those who sell. Those things are all regulated by a designated unit, usually the pound. I have had a lot of practical experience with fruit; I have been a farmer all my life, and I have never seen anyone defrauding or attempting to defraud me, nor have I attempted to defraud, by reason of these variations in the measures throughout the country.

Dr. WILEY. Probably you have scales on your farm and weigh what you buy.

The CHAIRMAN. I trust to my neighbor's scales.

Dr. WILEY. Most farmers have not, and they have to take the weights that are given to them.

The CHAIRMAN. I do not want to get into a controversy, but these things will come before the committee. The practical question is how to approach this. As I have said before several times, I have no quarrel with the system. I think it is ideal. But what I want to know is how to bring about its adoption or use in the most gracious and practicable way.

Dr. WILEY. That is what we are wanting you to do. We want you to pass the bill.

The CHAIRMAN. Emphasis has been given to certain phases of the matter, to which I do not attach much importance. One is the alleged frauds perpetrated upon the public in the selling of produce, and the great value this will be to the farmer. I think indirectly he would enjoy a uniform standard system, but to-day I do not think he is getting any less for his produce, or is being defrauded in money, by reason of the existence of our present system. Others on the committee, when it is brought to their attention, may take a different view, but I am giving you my view on that line.

Dr. WILEY. When a farmer sells wheat by the bushel he gets paid for 60 pounds. If he sells it to his neighbor, he sells it by a bushel measure. It may be 57 pounds; it may be 63. I never knew a farmer that weighed wheat when selling it among themselves for seed wheat. They just measure it up in a bushel.

The CHAIRMAN. There may be some of them that have a careless and shiftless way of doing it, like some men permit manure to accumulate around a barn until it rots the sides. But you know that most all wheat is sold to the elevators by a certain standard of quality and weight. There are certain ports where it is assembled for shipment abroad. The farmer usually receives under this system or any other just about what the product is worth measured by the demand and supply throughout the world.

Dr. WILEY. He receives the market price, yes; but that is no reason for saying that he gets what it is worth. It is worth what it costs him to produce it.

The CHAIRMAN. That is not the metric system.

Dr. WILEY. But that has nothing to do with the metric system, however.

There is one other point I would like to make, with reference to your remark about educational matters.

The CHAIRMAN. Yes.

Dr. WILEY. While there is nothing in this bill about education, there is a condition which confronts us here; there is no theory about it: Our boys and girls are spending hours and days, weeks and months, learning a complicated system which no human ingenuity could comprehend altogther, all of it. They are taking their time and sapping their vitality in learning a complicated system, which is so absurd from the scientific point of view that the educators themselves, the teachers, are a unit, as far as I know in support of this measure for the benefit and health of their children, of your children and mine. How much more good it would do a child if he did not have to spend his time in this and learn the simple rules of health and build up his vitality.

The CHAIRMAN. Do I understand you to suggest that the effort to learn the system that we use is undermining the health of the students.

Dr. WILEY. You ask the children of 8 and 10 years of age, who have studied our present cumbersome system, simple questions about weights and measures and see how backward they are. Ask them what a fathom is, a furlong. I venture to say there is not one out of twenty that would answer correctly. It is not impressed on them. Yet they have to learn them and recite them from memory.

The CHAIRMAN. A chain is a surveyor's measurement; I think it is 7.92 inches, is it not?

Dr. WILEY. It is a measure of length; yes.

The CHAIRMAN. And a rod is 16 feet.

Dr. WILEY. Yes. You have the inch, the foot, yard, furlong, mile, fathom, and a number of other measures of length. Yards and chains are measures of length.

The CHAIRMAN. Those are complicated tables, and the average individual does not use them. He uses the inch and the foot. He knows what the gallon is and the quart.

Dr. WILEY. Which gallon does he know? For instance, in many States the beer gallon by act of the State legislature is different from the 231 cubic inch gallon, and in two States the beer gallon and milk gallon are 282 cubic inches, while the standard gallon is 231. Beer and milk are put together in a big measure, so the farmer has to sell a great deal more milk for a gallon, the same as he would sell beer. But he can sell molasses and other things in much smaller quantity per gallon.

The CHAIRMAN. The statement has been frequently made that a person of ordinary intelligence and education could acquire all they need to know about this system in 30 minutes.

Dr. WILEY. I made it a little shorter than that.

The CHAIRMAN. What is yours, 15?

Dr. WILEY. Yes; 15 minutes.

The CHAIRMAN. You were speaking about chains and links; that is going into the minutiæ af the present system. If you went into the minutiæ and the ramifications of the metric system, such as I see in tables of length, tables of capacity, tables of area, tables of volume, and tables of equivalents or double markings, I think one would spend a great many months on it; but you folks come here and say, because there are a few decimals the person must know and a few terms, that is the system. That is the foundation, but you must go to complicated tables to work out your problems, such as you do in the present system.

Dr. WILEY. If you have to convert our methods into the metric system, of course you get a complicated set of figures, but they have only one value. There is only one cubic meter.

The CHAIRMAN. Of course I am glad to have your opinion about it, but I do not think it helps the record any to say that the comprehension of the system is literally like rolling off a log.

Dr. WILEY. Senator Jones asked me particularly to say something about this point, as to what is the best way in which this system can be introduced. I have thought a good deal about that, because I consider it a very important point, and I have come to this conclusion, Senator. It may be the view of an enthusiast, but still it is a view, and I am going to give it for your consideration:

In my opinion the best way to do this is to make the United States at once, as it was in the medical service, the user of this system. I would suggest

putting into this bill a provision that one year after the date of the passage of this act, all business transactions of the United States of every description involving weights and measures, shall be conducted solely in the metric system. That is one thing we can do without treading on anybody's toes, just as they did in the medical profession, and they all welcomed the change.

If you will put that provision in the bill, that all business of the United States shall be conducted in the metric system, you will see that it will be easy in 10 years to have all bodies come to it.

The CHAIRMAN. I am glad of that thought. Of course that is one of the plans conceivably possible. But yesterday representatives of the Army and of the Navy were here, and they loudly protested against the adoption of the system at this time.

Dr. WILEY. The system they have?

The CHAIRMAN. The metric system.

Dr. WILEY. In medicine?

The CHAIRMAN. No. The Army and Navy protested——

Dr. WILEY. It was not a medical man, then?

The CHAIRMAN. No. Of course all medical men are for it. So if you attempt to have it adopted as a system the Government should use, you are going to find a whole lot of opposition right in the governmental establishment.

Dr. WILEY. Certainly you will. But you have been in Congress a long while, Senator. Did you ever propose any reform in the Army that some Army officer did not come up and oppose it?

The CHAIRMAN. That is true.

Dr. WILEY. That is no reason that the opposition is based on sound principles. You can not get the people of this country to think alike about the tariff or about the tax bill.

The CHAIRMAN. Going back to your remedy, which I am very glad to have you discuss, you would first have the Government initiate the system?

Dr. WILEY. Yes, sir.

The CHAIRMAN. Then, would you stop with that, trusting that others would follow?

Dr. WILEY. I would not shorten up this period in the bill.

The CHAIRMAN. You would go right ahead with the bill?

Dr. WILEY. Yes; I would go ahead with the bill. I would not change any part of the bill except that.

The CHAIRMAN. Leaving 10 years as the period of transition?

Dr. WILEY. Yes. If you make it 100 years, there will be nothing done until the ninety-ninth year. But if you make the United States Government use this system everybody that wants to do business with the Government has got to learn it and use it. That would be the greatest educational method of introducing it, in my opinion.

The CHAIRMAN. It would cost the Government very many millions of dollars, would it not?

Dr. WILEY. No; it would save it many millions of dollars, just as the representative that was here the other day told you how much it had saved him in clerk hire—50 per cent in clerical services—by the use of the metric system, so simple it is. It would save this Government millions and millions of dollars in clerk hire, in computing, in architectural work, and in everything that enters into the real business of the Government in buying or selling. It would be a wonderful help to the Government.

Senator, suppose we were to go back and try to use our present system in chemical science, it would be a death blow, almost, to chemistry to have to make computations in our old system. It would take so much time for computing that the men would never have any time to investigate.

The CHAIRMAN. I realize the great value it is to chemistry.

Dr. WILEY. I want to show you what Congress has done, again, for this system. It has done a lot that people don't know about. I hold in my hand, Senator, the most valuable coin, in my opinion, ever struck from the mint. It it a 5-cent nickel piece. It is a measure of value. Presumably we can go into a store and get 5 cents worth of goods. I say "presumably"; at least, we can pay 5 cents with this nickel. But we can do more than that. If you have enough of them, when the grocer sends the butter home you can weigh it. That weighs exactly 5 grams, by act of Congress. That is the only decimal coin in weight that we have.

I have looked over the other coins that we have. The slightest little change, *without changing one* iota of their intrinsic value, could make all of our coins

weights. Congress has already inaugurated the nickel. And it came pretty near doing it with the diameter. The diameter of that nickel is almost a centimeter. If they had thought about it I have no doubt Congress would have made the diameter exactly 1 centimeter, so that it would be a measure of length, by the slightest little change in it without changing its value at all. You could not tell the difference by looking a it. That change would not only make it weigh exactly 5 grams, but by being a little bit thicker and a little bit narrower it would be a measure of length. You could put them together that way and measure distance with them.

Congress has realized in this way—or put in practice, I might say—the theory of the value of the decimal system. Why did they make this 5 grams? Because that is a weight, a standard weight. The world over knows 5 grams. The 10-cent piece, or the 25-cent piece, or the dollar, and the gold coinage could all be made in the metric system, and all will be in time to come. But that is not important, because it is all in the decimal system anyway. But they would be more directly corelated with this system by making standard weights and diameters, so that our money system would be worked exactly as in the case of the 5-cent piece, which has already opened the door to the passage directly from the standard meter in Paris to the weights and diameters of our coins. That would simplify coinage. And you will see that gold dollars, which contain 6, 7, 8, 9, 10, 11, or 12 decimals of a grain, all will be wiped out and simplify our coinage.

I have studied this problem now for a lifetime or more of most people, and every time I turn my attention to it I find some additional reason for favoring this proposition. I realize the strength of conservatism, and I am glad we are conservative. I think conservatism is the salvation of the world just now, hanging on to the old stuff as long as it is necessary. But there are two kinds of conservatism. There is a dogmatic, unreasonable conservatism, and there is a reasonable scientific conservatism.

I do not favor sudden changes. I would not favor any kind of a compulsion in this matter. I would like to see this come in, if it could, without any time limit on it. But I fear it would not come. If we can get the United States Government to work on it right away, that will be the greatest lever and the greatest educational implement that we could have. Then everybody would say, "Well, if I want to do business with the Government I have got to understand this new system," and he would go to it in such a way that it would be easily done. That is what I offer in response to the request of Senator Jones—that we do this as we did in medicine in the Army and Navy medical service in one year.

Senator, the United States to-day has complete sets of weights and measures in every customhouse and in every post office. under act of Congress requiring it. So that as far as weights and measures are concerned they are all at hand. There would be no additional expense at all in getting new standards, because they are already provided. The law also requires Congress to provide the States with copies of the metric standards, and they are all provided already. Every State has its standards, given free by Congress. And they also say that the municipalities, and other persons in private life, may buy of the United States these sets of standards. That is provided for by act of Congress. So that this is no new legislation we are asking for. It is only as a supplement and completion of legislation already enacted.

I have no doubt that if in 1866 much publicity had been given to this proposed legislation legalizing the metric system, you would have found all kinds of people up here opposing it. I am sure you would. But I imagine it was put through without much publicity, like a good many good laws have been put through. But I welcome all kinds of investigation and all kinds of opposition, because it only throws additional light upon the subject and makes, it seems to me, our position stronger.

That is all I have prepared, Senator. I will try to answer any questions you may care to ask me.

The CHAIRMAN. I think you have covered the whole subject in a most intelligent and entertaining way, Doctor. It will be very useful to the committee.

Dr. WILEY. I will ask permission, as I said before, to check this statement up, and return it for the record.

The CHAIRMAN. Very well. We are very much indebted to you, Doctor.

STATEMENT OF MR. CONSTANTINE E. McGUIRE, ASSISTANT SECRETARY UNITED STATES SECTION INTER-AMERCIAN HIGH COMMISSION.

The CHAIRMAN. Mr. McGuire state your name, residence, and occupation for the benefit of the record.

Mr. McGUIRE. Constantine E. McGuire; assistant secretary of the Inter-American High Commission.

My contribution, Mr. Chairman, will be very brief, and will be taken up with but one feature of the problem before you, namely, the relation of our trade with the Republics of Central and South America to this question.

I am here representing the United States section of the Inter-American High Commission, an organization which was established six years ago, and which is a union of the ministers of finance of the American Republics. Each minister of finance is the chairman of a national section of this commission, consisting of eight other persons in his country—jurists or financiers.

This body has to do with the uniformity of commercial law and fiscal administrative practice and procedure; and in the second place, with means to stabilize exchange. Those are the two chief problems with which the commission is concerned. It has nothing to do with diplomatic relations, and for that reason is not in the Department of State; nor has it to do with the direct promotion of trade, and for that reason is not in the Department of Commerce. It has to do, rather, as I said before, with uniformity of fiscal procedure and with means to stabilize exchange.

In the course of its work, coming in contact with the ministers of finance and with the respective national sections, its employees—that is my colleagues and myself—have had impressed upon them the constant amazement of the Latin-American officials and financiers that the United States has, as they put it, so long hesitated to take the step here suggested, that it make uniform its system of weights and measures with those legally in use throughout the world.

In the course of that work it was necessary for me to go to South America in 1916. I visited a number of cities, and while not concerned directly with commerce in the sense of having to sell goods or buy them, I visited a good many stores. It has been said, and that is the reason I mention the fact, that there are many customary units in use in the Latin-American countries. While that may be true in remote and isolated communities—it may be true to some extent in regions that are not thickly settled or developed, among the population of Indian descent—it is certainly not true in the large cities, or in any kind of commerce that comes even indirectly in touch with international trade. It is not true in any of the computations with which bankers have to do, with which Government agencies have to do.

Nowhere in the revenue laws of the 20 other republics in this hemisphere will you find any reference to customary units; nowhere in the legislation enacted with respect to excise and inspection of goods, in the administration of pure-food laws, health laws, and the like, will you find any reference to other systems of weights and measures than the decimal metric system.

I mention that because it has been sometimes pointed out that the customary units are in use not only in Latin-American countries but in other parts of the world.

The question has also been asked a good many times to what extent does the fact that we use our traditional customary system operate as a direct obstacle to the promotion of our trade in the other republics which use the international decimal metric system? Our answer to that would be that it is an obstacle that frequently is sufficient to throw the decision to our prejudice, other things being equal.

A great majority of the larger machinery manufacturers, the great houses that have had growing need of developing their foreign trade, have, of course, facilities for handling orders in the decimal metric system coming from Latin-America or other foreign trade and they experience no difficulty because they parallel all their domestic orders, their domestic means of supplying orders, with this system for handling the foreign trade.

But the great concerns, the great corporations, that are the result of the integration of industry, need never be the concern of Congress. They are always very well able to look after themselves abroad. It is the group of corporations and companies and individuals of the second and third rank that are more or less on the margin when it comes to devising means of promoting trade, that are the constant concerns of Congress. Every device that will promote their pros-

perity abroad is of importance. It may be a measure with respect to legalizing operations of theirs, financial operations; it may be a measure permitting them to do things which at home, because of a long development, could not be permitted.

But in this instance, if they are told that they are free to build up systems of handling Latin American orders, just as the Baldwin Locomotive Works and a dozen other large concerns have been free to do, and have done it, their answer will be that their means, their resources are not adequate to enable them to handle two systems.

I could cite in some detail the Latin-American legislation if that were wanted.

The CHAIRMAN. No; we have access to that.

Mr. MCGUIRE. But I know you have that. I will, however, call attention, if I may, to the fact that whenever there have been international gatherings of representatives of the American Republics to discuss the general problems confronting them all, or to discuss particular financial or technical matters, this question has invariably come up and resolutions have been presented and adopted, even by the delegates representing the United States with, of course, reservations, to the effect that it was and is desirable that systems of weights and measures used currently in international commerce, should be uniform.

In 1889, in the conference called by Mr. Blaine, there was a long report, a valuable report, submitted, and the conclusion was that the American Republics should adopt the decimal metric system of weights and measures.

Again, in later international conferences reports of a similar character were adopted. The United States section of this commission for which I am speaking here, has twice had the matter brought to its attention by other sections of the commission, and has adopted resolutions recommending the matter to Congress as of serious importance. I would be glad to send a brief synopsis of those resolutions to you if it is desired.

The CHAIRMAN. When can you get them here?

Mr. MCGUIRE. I can send them this afternoon. I merely want to go over it and make sure that all the citations from Senate and House documents are accurate.

The CHAIRMAN. Very well.

Mr. MCGUIRE. Also I would be glad if I might be permitted to file a statement from my colleague in this commission, who was called to the State Department this morning and was unable to come, Dr. G. A. Sherwell.

The CHAIRMAN. Very well, Mr. McGuire; they will go in the record.

(The papers referred to are here printed in full, as follows:)

REPORT AND RESOLUTION OF THE FIRST INTERNATIONAL CONFERENCE OF AMERICAN STATES HELD AT WASHINGTON, 1889–90.

[Fifty-first Congress, first session, Executive Document No. 181.]

The committee appointed by the honorable president to inquire into the advisability of the adoption by all the nations here represented of a uniform system of weights and measures have the honor to submit the following report:

The need of establishing a unit of comparison for everything susceptible of being weighed or measured was doubtless recognized from the remotest antiquity; or rather from the time when, the right of ownership being acknowledged, the batering or exchange of commodities became a definitely established practice.

History shows that this unit of comparison was generally some portion of the human body.

The Hebrews, as well as the Carthagenians, Phoenicians, and Egyptians, had as their principal measure of length the foot.

Later the Greeks and Romans added to the number of their mesaures the finger, the thumb, or inch, the palm, the fathom, the pace, the double pace, etc., the names of which indicate the source whence they are derived.

These are the measures which even after the lapse of centureis have been in use in the greater number of civilized nations.

But as the human body varies so much in size the measures adopted from it are necessarily arbitrary. At the present day even the learned are not agreed about the exact length of the Greek and Roman foot, being divided in their opinions among various estimates.

It is evident, then, that such a standard of measurements has not and can not have a constant and uniform basis even at a given period, and still less at different times, or with reference to different races at the same time.

Such considerations induced the Constituent Assembly of France, in the last decade of the eighteenth century to adopt as the basis of a system a simple and invariable dimension susceptible of ascertainment at all times.

So, by decree of May 8, 1790, upon the motion of Mr. Talleyrand, it was ordered that a commission composed of French savants, to be appointed by the academy, should be charged with ascertaining the length of a simple pendulum which would mark a second at the sea level in latitude 45°. The same decree provided that the Government should request the King of England to appoint a committee from the Royal Society of London to cooperate with the French commission with a view to establishing a common system of weights and measures, and recommending its use to the other nations.

The French delegates nominated by the academy were Lagrange, Laplace, Monge, and Condorcet. The English Government declined to cooperate, assigning as a reason the political contentions then agitating France.

The French commission, departing from the original program, which contemplated chiefly the determination of a pendulum vibrating seconds, considered the question whether it would not be better to take as a unit of length a fraction of the earth's meridian. This idea having been adopted, for fear that there would else be difficulty in securing for the new system the approval of those nations whose territory was not intersected by the forty-fifth degree, the commission on the 17th of March, 1791, presented to the National Assembly a report in which it proposed to adopt as a fundamental unit the one ten-millionth of a quarter of the earth's meridian, and to give to this unit the name of meter. In accordance with these recommendations, Mechain and Delambre were charged with the delicate problem of measuring the arc of the meridian included between Dunkirk and Barcelona. Mechain and Delambre found the quarter of the meridian equal to 5,130,740 toises, which result was adopted by the legislative body on the fourth messidor of the year VII (June 22, 1799).

The same measure of length served also as a basis for establishing the unit of weight called a gram, adopted by the law of the eighteenth germinal, year III. This is the weight in a vacuum of a cubic centimeter of distilled water, taken at its maximum density, which corresponds to the temperature of 4° centigrade above zero.

The expressive nomenclature with its concise prefixes, the ascending and descending series of multiples and submultiples, and the facility with which it lends itself to decimal calculation make this simple and admirable system the only one worthy of universal adoption by civilized nations.

In fact, in 1873 an international commission, known as the (International) Metric Commission, met in Paris with a view to agreeing upon the adoption of a universal system of measures. England, Russia, Austria, Germany, Bavaria, Würtemberg, Switzerland, Italy, Spain, Portugal, Belgium, Holland, Sweden, Denmark, Turkey, the United States, and several of the Spanish-American Republics were represented by distinguished scientific men. After careful deliberation they abandoned the idea which had been entertained of a new measurement of the earth's meridian, recognizing the fact that such an undertaking would be attended with great difficulties and could yield only uncertain results, and they agreed to adopt the French meter, the standard of which is preserved in the French archives.[1]

The same decision was taken with regard to the kilogram as the unit of weights.

The commission also recommended certain necessary precautions for securing the accuracy of the standard meter according to the dimensions fixed upon.

Finally, a convention for securing the international unification and perfection of the metric system was signed in Paris on the 20th day of May, 1875, which convention was ratified by the Governments of the following nations: Switzerland, Germany, Austria-Hungary, Argentine Republic, Denmark, Spain, Italy, Peru, Portugal, Belgium, Brazil, United States, France, Russia, Sweden and Norway, Turkey, and Venezuela.

The following gave their decision afterwards: Serbia in 1879, Rumania in 1882, Great Britain in 1884, and Japan in 1885. The Republics of Chile, Colombia, Ecuador, Bolivia, Costa Rica, Mexico, Salvador, and Uruguay have also adopted that system.

In a recent lecture delivered before the Academy of Sciences at Paris, M. de Malarce said:

---

[1] In the International Metric Bureau, which 17 nations contribute to support and direct.

"That in 1877 the use of the metric system was obligatory in various parts of the globe, that system being the one employed by 302,000,000 persons; that in the course of 10 years it had been adopted by 53,000,000 more; that in the same year, 1877, various countries containing a population of 97,000,000 voluntarily adopted the use of this system; that it was also legally admitted in Russia, Turkey, and British India, which had the same year, 1877, a population of 395,000,000, thus receiving in 10 years an addition of 545,000,000. In China, Japan, and Mexico the decimal system prevails, but not the metric. This last has been adopted and legally recognized by 794,000,000 souls, and the decimal system is in use among 470,000,000 of inhabitants in the three countries last named. So that only 42,000,000 persons exist who reckon according to the ancient system of weights and measures and who do not recognize the metrico-decimal."

Recently the United States Government received official facsimiles of the meter and kilogram agreed upon in the International Metrical Conference held in Paris in September of last year, and the boxes containing them were officially opened on the 2d instant at the Executive Mansion in the presence of the President of the Republic and other functionaries and certain distinguished personages specially invited for the ceremony.

RECOMMENDATION AS ADOPTED BY THE CONFERENCE.

The advantages which the metrico-decimal system offers being so evident, and that system having been already adopted by so considerable number of nations, your committee recommend the adoption of the following:

"*Resolved*, That the International American Conference recommends the adoption of the metrical decimal system to the nations here represented which have not already adopted it."

SECOND INTERNATIONAL CONFERENCE OF AMERICAN STATES AT MEXICO CITY, 1901–2.

[Senate Document No. 330, Fifty-seventh Congress, first session.]

" * * * Each of the American Governments shall send, from time to time, at least once in each year, to the International Bureau of American Republics the most complete information and statistical data possible with regard to its population and natural resources, as well as the statistical matter on manufactures and commerce and on any other matters which it may deem useful for the development of the economic relations of America. The bureau is charged with giving special attention to the obtaining of the statistical data referred to, and, as soon as the same are received, is to classify, properly arrange, and publish them.

"The data on weights and measures are to be given according to the decimal system, with a statement of their equivalents according to the system of each nation which may have a different system."

FOURTH INTERNATIONAL CONFERENCE OF AMERICAN STATES AT BUENOS AIRES, 1910.

[Senate Document No. 744, Sixty-first Congress, third session.]

Recommended "The rigorous observance of the decimal metric system, so as to procure a possible uniformity in all that relates to weights and measures."

RESOLUTION ADOPTED BY THE UNITED STATES SECTION, INTER-AMERICAN HIGH COMMISSION AT ITS SESSION ON OCTOBER 7, 1918.

"A bill having been introduced by Congressman Charles H. Dillon, of South Dakota, to make compulsory the use of the metric system of weights and measures within the jurisdiction of the United States (House bill 151), and Secretary McAdoo having expressed himself with regard to this matter in a letter of January 15, it is earnestly recommended that the section go on record in favor of this bill and that it direct the office of the secretary general to transmit to the chairman of the Committee on Coinage, Weights, and Measures of the House of Representatives an expression of its belief that the best interests of the country will be served by the passage of this bill."

RESOLUTION ADOPTED BY THE UNITED STATES SECTION, INTER-AMERICAN HIGH COMMISSION AT ITS SESSION ON OCTOBER 7, 1918.

"The United States section of the International High Commission, having in view the present efforts to bring about the exclusive use of the metric system of weights and measures within the jurisdiction of the United States, resolves:

"1. That in the opinion of the section, the adoption of that system would be productive of great advantage in the commercial relations of the United States with the other American Republics;

"2. That the secretary of the section be directed to communicate a copy of this resolution to the chairman of the proper committees of the Senate and the House of Representatives."

STATEMENT OF G. A. SHERWELL, JURISTIC EXPERT, UNITED STATES SECTION INTER-AMERICAN HIGH COMMISSION.

TREASURY DEPARTMENT,
October 27, 1921.

The undersigned believes that legislation providing for the compulsory use of the metric system of weights and measures would facilitate international commerce, and consequently favor the development of our national industries.

This phase of the subject has been thoroughly discussed, and the reasons favoring or opposing the adoption of this measure have been carefully weighed and appreciated. A short summary of them would serve, nevertheless, to bring to light the weakness of the opposition to this progressive development.

Perhaps the main argument of the opposing party consists in the statement that since our national industries have prospered so wonderfully using the old system of weights and measures, there is no reason to change what has given such good results for what is an unknown quantity. The fallacy of this argument lies in the fact that the development of our industries has been due to many factors of materials, climate, location, and the like, and has been obtained not because of, but in spite of, our antiquated system of weights and measures. Nobody would deny, of course, that if the general conditions which prevailed in the past were to continue to prevail in the future, American industries would continue to develop. The issue between the customary system of weights and measures and the metric system is reduced to the ascertainment under which system will our manufacturing industries and trade have the smoother development. The answer by force of logic must be that the adoption of the metric system will facilitate the development of both manufacturing industries and commerce, since it prevails all over the world with the exception of the English-speaking communities, in which, nevertheless, many industries have been forced by circumstances to make more and more frequent use of the metric system.

To judge the merits of both systems, or rather, to consider the advantages of either without realizing precisely what is our present stage of industrial development, leads to error. When we were a self-supporting community, from the industrial standpoint, we could get along with any system, no matter how absurd it might have been. But in our progress we have arrived at a stage of development in which we are more and more dependent upon other countries and upon foreign markets to purchase what we need and to sell what we produce in excess of our needs. Foreign markets are open to the sellers and purchasers who meet those with whom they have to deal on a common ground of weights and measures. There is the natural tendency to avoid having to deal any more than necessary with those whose terminology is entirely distinct.

The rapid development of our world trade from 1916 on was due to the sheer necessity of the belligerent and neutral countries. We could then impose our system of weights and measures. But since conditions have changed so markedly and give indications of still further extensive change, we are confronted with the necessity of meeting the world halfway and doing everything proper that we can to propitiate our foreign customers, for they will not come to us through any feeling of friendship, but will come only if they see that we try to satisfy their needs and even their caprices.

Another strong argument presented by the opponents to the adoption of the metric system in the United States consists in the declaration that, as a matter of fact, no country uses exclusively the metric system. It is pointed out that in Spain and Spanish-American countries in some classes of society, simultaneously

with the units, multiples, and submultiples of the metric system, there are used old-fashioned measurements not everywhere uniform. This assertion is not true on so extensive a scale as some writers have implied, but for the sake of argument it may be conceded. But even so, it does not mitigate against the adoption of the metric system. For the existence of all other systems of weights and measures in the different countries simultaneously with the metric system only emphasizes the necessity of preventing the continuation of the existing chaos by having one of the several systems of weights and measures in use prevail over the others, at least as far as international transactions are concerned. The problem, then, would be reduced to the examination of the various systems in order to determine which is the most generally adopted among peoples and by governments, the simplest and most easily taught and understood, and at the same time the most scientific and reasonable. Nobody can deny that all these conditions are met by the metric system.

Since we can not prescribe the metric system for exclusive use in international trade without also prescribing it for domestic use, it follows that the metric system should be adopted for all purposes.

It has been pointed out also that a change of system would entail great expenditures on the part of most of our manufacturing concerns to conform to the new measurements. Perhaps in some cases adaptations would be necessary, but frequently no change would be required, for the substitution of the metric system would merely call for the adoption of a new nomenclature.

Every progressive step in industry has met the same argument. Men are prone to get into ruts and never to get out of them; yet they will, on reflection, not fail to welcome a measure which is obviously helpful. Any money spent for the installation or adaptation of machinery to conform to the new measurement would in the long run prove profitable through an increase of production and greater facilities for foreign consumption of our manufacturing products.

The metric system, once adopted, would prove its superiority by the readiness with which it would be understood by everybody. Our customary units of weights and measures are learned with difficulty and quickly forgotten. Even among the advocates of the customary system might be found some not able to answer simple questions regarding the divisions, subdivisions, and equivalences of the old system of weights and measures, while the fundamentals of the metric system can be quickly learned by any person of average intelligence and once learned can not be forgotten. The simplicity of the system is such that a knowledge of it remains in the mind with the strength of all the most simple and elementary things.

GUILLERMO A. SHERWELL.

Mr. MCGUIRE. Are there any questions, Mr. Chairman?

The CHAIRMAN. You think, then, the adoption of this system would promote trade with the South American and Latin-American countries?

Mr. MCGUIRE. I think so.

The CHAIRMAN. That seems to be the heart of your statement.

Mr. MCGUIRE. It is the heart.

The CHAIRMAN. I think you have covered it very well, Mr. McGuire. It is a development of the subject in a different way, and the committee appreciates the statement you have made.

STATEMENT OF MR. ARTHUR P. WILLIAMS, NATIONAL WHOLESALE GROCERS' ASSOCIATION OF THE UNITED STATES.

The CHAIRMAN. State your name, address, and occupation to the reporter.

Mr. WILLIAMS. Arthur P. Williams, of R. C. Williams & Co., New York City. Senator, I represent the National Wholesale Grocers' Association of the United States, and the New York State Wholesale Grocers' Association. The National Wholesale Grocers have a membership of 868 of the largest firms and corporations in the grocery business in the United States. We employ approximately 275,000 people and do a business over $3,000,000,000.

For 10 consecutive years we have passed a unanimous resolution in favor of the immediate adoption of the metric system.

The New York Wholesale Grocers' Association comprising 126 of the largest wholesale grocery houses in the State of New York, doing a volume of business amounting to over $300,000,000, and employing over 58,000 people, have passed unanimous resolutions in their last eight conventions. Many retail State organizations and the national retail organization have also passed similar resolutions. The California Wholesale Grocery Association have passed similar resolutions,

I believe, Senator, the reason that the grocery trade has taken this position is due to the things that Dr. Wiley has brought up this morning. We handle these various packages with various weights, and we endeavor to sell a 44-pound bushel to a 56-pound State.

We have also run into endless errors which are extremely costly. I personally figure that my firm alone will save $10,000 annually in mistakes in figuring invoices and in shipping goods through our complicated system.

I was personally converted to this system in South America when I went there in 1912 to sell my goods; and I went there, Senator, to sell Oregon canned fruits, for example. That is what I went there to sell—American canned goods. I found there in 1912 that our competitors were Germany, Belgium, Italy, and France. They were the people selling the canned goods in South America in the largest volume. They were delivering units of weights and measure that were understood by the consumers of South America, the common people, in packages of very simple denominations, 250 grams, 500 grams, 1 kilo, or 1,000 grams—commonly called 1 kilo, half kilo, and quarter kilo. They were packed and shipped in units of 100. There would be 50 tins in a case, 100 tins, or 200 tins.

Immediately on returning to New York, this question of the metric system being on the packages of food products in South America had impressed me so strongly that I immediately ordered the double marking of my own labels, putting the metric system on the labels, so that at least I would go into that market with an intelligent label for the consumer. That I have recommended to the trade in the grocery business. It is being done by a large number of manufacturers, with the double idea of educating the people to the metric system of markings and also for the foreign trade.

Now, Senator, when the system is adopted, and I sincerely trust it will be, this unit will probably be 500 grams. This tin can will be one-half a kilo [indicating]. When we go into Oregon, the No. 2 can of Oregon pears—this is a No. 2 can of pineapples—will be made into a 500-gram can, probably. The size smaller, which is now the individual can of Oregon fruit, will be 250 grams, a quarter kilo can. And the common California 2½ fruit will be 1 kilo. That is all there is to it. With that you can make your gallon tin to-day, say, three kilos flat—3,000 grams, 3 kilos.

In other words, it will be economy to the canned goods packer in Oregon or anywhere else in the country. It will mean the elimination of thousands and thousands of sizes that we use to-day, such sizes, Senator, without going into all the detail, as the 6-ounce tin, the 6¼, the 7½, the 7¾; in the case of canned salmon, the 8-ounce tin, 9-ounce, 10-ounce, 11-ounce. It is not necessary to repeat them all—15½ and 16 ounces, and so on up to the eights and tens.

I believe that with the introduction of the metric system, when all those would be eliminated and we would get down to a standardized can and a standardized package, that the consumers of the United States would save millions of dollars. I do not believe the average woman knows what she gets when she buys a can that is marked 1 pound 4 ounces, 1 pound 5 ounces, 1 pound 7 ounces. I do not think it amounts to much.

We are being offered new sizes every morning. I will buy a can called No. 2. It is shipped to my firm, and I suddenly discover that they have trimmed off an ounce. I have no appeal. It is No. 2. There is no standard about it. They take off an ounce. My people ask what does it amount to? It is a new size that has been put on the market, and I accept it.

The CHAIRMAN. It would seem to me if you desire a common standard you grocerymen could bring about an understanding like the chemists have, like the apthecaries and the engineers of the country. Why are you so helpless when great millions are being lost by changing the size of the can and the quantity and contents every few days? Can't you control that?

Mr. WILLIAMS. No; it is impossible.

The CHAIRMAN. If you as a grocers' association would notify the cannery men of the country, who manufacture cans, that you would not deal in their goods, unless they had a one-pound can a 1½ can, etc., you would find them conforming eagerly to your demand, because they would have to, or they would be run out of business. It looks to me that in this life sometimes the individuals should do something for themselves and not always come asking the Government to do something for them. Why is your case different than the one that Dr. Wiley gives and other cases?

Mr. WILLIAMS. Senator, I think we are looking at it from a wrong point of view. There is no reason particularly why we should not have all these dif-

ferent sized cans, if a man decides to pack them that way, but it is very uneconomical, it is very ridiculous to have all these different sizes. I do not think anybody benefits by them. On the other hand I think everybody suffers by this eternal change of size. I do not say a man cheats me when he ships me a different sized can, but nevertheless it is uneconomical to switch sizes.

The CHAIRMAN. If the thing is uneconomical, then the great law or the science of commerce ought to adjust it. It does in other things. Why does it not operate in this field if everybody is losing by it, from the packer to the consumer? Why does it not correct itself?

Mr. WILLIAMS. It is getting worse instead of better, as a matter of fact. It is getting continuously worse, in my opinion. I think, for example, if you called in the heads of the American Can Co. and asked them, in their opinion, would the adoption of the metric system result in standardization of cans, and in turn would that be economy for their company, and could they sell their cans cheaper to the canner, who in turn would make a lower price to the consumer, I think the answer would be "Yes."

The CHAIRMAN. There is a lot in what you say, Mr. Williams, but I have no doubt that the variation in the sizes of cans can be remedied without legislation. Do you think this is the form and the way to reach it, by this bill?

Mr. WILLIAMS. I believe it is exactly the way to reach it, and I believe further, Senator, that if this bill should come close to adoption, that the average merchant would take up the metric system and adopt it.

They tell me that the cost is going to be terrific. That is the only argument I have ever heard against it. We buy a great deal of machinery. We buy machinery for packing, for filling bottles, for corking them, for labeling bottles. We buy machinery to pack these cases of canned goods. I buy this myself and I check the invoices and I know the cost. And I know that by the time we get a bill paid and the machine working nicely, the fellow comes along with an improvement, and it is so much better than the old one, that the old one in a short time has to be scrapped and thrown away, and we change to the new and improved machine. You might call it cost, but it gives greater efficiency and it is an economy. I therefore buy the new machine, discard the old one, and go ahead.

They tell me that when you get in the metric system something has got to be scrapped and it is going to be a terrific loss. We use a great many automobiles in our business. After 10 years a new model comes along that is so completely better than the old one, and so changed, that the old machine is obsolete and it is scrapped.

Dr. WILEY. May I add just a point?

The CHAIRMAN. Certainly.

Dr. WILEY. Toward easing the public mind in regard to this matter: I do not think it is necessary to require that we should use the word "kilogram," because we can give a value to the pound. Just say in the bill a pound shall be 500 grams and a quart shall be one liter. Let us keep the quarts and pounds, and the gallons and the yards—say a yard shall be a meter. Don't let us scrap our names. That is the principal thing we do not like to give up, the name. I will go in and get a pound of sugar, and I will be given 500 grams. You can just put it in the law. It would be a simple thing. We need not change names. But say the value of the pound is 500 grams instead of 454. It is almost the same. There are some quarts which are bigger than the liter and some that are smaller; but say a quart shall be a liter.

In that way it would relieve the public's apprehension about new names. They could buy by the pound, the gallon, and so on, just the same as before. But the gallon would be standard and be equivalent to 4 liters.

Mr. WILLIAMS. I can not quite agree with you, Doctor, because I think that is a bit provincial. In other words I think we have become a world nation to-day. I do not think we realize that we are out in the world. We have been living in America bounded by the Atlantic and Pacific Oceans for many years. Suddenly we step out into the world and become a world factor. We have adopted world methods. We manufactured war material in the metric system for the European countries when we gave them their guns, and so on. The metric system is known everywhere and used everywhere except in England and America. Russia and Japan are taking it up. In a few years they will use it. I am selling the Russian Government and shipping goods to-day. When they get over there they are given to the starving people, so it don't make any difference. But if I do business with Russia five or ten years hence, which I probably will, I

must deliver the goods over there in the metric system. Why not make the step?

I tell you, gentlemen, I go back to the history of this thing, and I look at the Continental Congress, and Thomas Jefferson putting this thing before the people, adopting dollars and cents and yet throwing aside the dollars and cents of weights and measures. As to the question of how long it would take you to learn the metric system, how long did it take you to learn dollars and cents, Senator? You didn't study dollars and cents; it just came to you, didn't it? This system comes to you. When you go to France, inside of a week you are thinking in their units. It is no study. It just comes to you naturally. To-day I would not know our weights unless I referred to a book which I always keep close at hand.

Dr. WILEY. Our soldiers when they came back from abroad spoke of miles in kilometers.

Mr. WILLIAMS. I have traveled a great deal in Europe, and I have come in contact with the system more than the average person, perhaps. But it is so simple that there is nothing to study about it.

I should like to submit the action taken by the city council of Chicago on the subject of the metric system.

The CHAIRMAN. Very well.

(The paper referred to is as follows:)

[From Journal of the Proceedings of the City Council of the City of Chicago, Ill. Regular meeting. Wednesday, May 26, 1920. Pp. 208–209.]

METRIC SYSTEM—ADOPTION AS THE LEGAL STANDARD OF WEIGHTS AND MEASURES.

The committee on judiciary, to whom had been referred (Mar. 3, 1920. p. 2058) a resolution requesting that the units of the metric system be adopted by the Congress of the United States of America and the British Parliament as the exclusive legal standard of weights and measures, submitted a report recommending the adoption of said resolution.

Alderman Olsen moved to concur in said report and to adopt said resolution.

No request being made by any two aldermen present to defer consideration of said report for final action thereon until the next regular meeting, and the question being put, the vote thereon was as follows:

Yeas: Coughlin, L. B. Anderson, Jackson, Passmore, Schwartz, T. A. Hogan, Richert, McDonough, Mulcahy, McCormick, Eaton, Fetzer, Guernsey, Woodhull, Furman, Madderom, Govier Klaus, McNichols, Horan, Rutkowski, Cermak, Cepak, Shaffer, Horne, Maypole, J. H. Smith, Kaindl, Olsen, Kunz, Piotrowski, Adamkiewicz, Walkowiak, Touhy, Kavanagh, Powers, Bowler, Frick, Franz, Crowe, Agnew, Hibbeler, Wallace, Steffen, Dorney, Haderlein, Link, Lipps, Caspers, Armitage, Jensen, C. F. Smith, Adamowski, Kovarik, Byrne, Burns, O'Toole, S. M. Hogan, Moran, Fisher, Lyle, Garner, Kostner, Toman, Clark, Lynch—66. Nays: None.

The following is said resolution as adopted:

"Whereas the experience of the recent war has further emphasized the very great need for world standardization of all weights and measures through the adoption of metric units; and

"Whereas the present antiquated jumble of weights and measures now in use in this country is a hindrance to education, industry, world trade, and all activities of daily life, and has proved a handicap in the World War, and will handicap us in our future dealings with the other civilized nations of the world, the vast majority of whom have now adopted metric standardization with the exception of the United States and the British Isles; and

"Whereas the metric system is simple, logical, and easy to use because it is a decimal system with only three units—the meter, liter, and gram—and

"Whereas efforts are now being made throughout the United States and Great Britain to bring about the exclusive use of the meter, liter, and gram by both America and the British Isles; and

Whereas the city of Chicago, by reason of its great engineering, business, and health activities, yearly amounting to many millions of dollars, is vitally interested both as a municipality and in behalf of its citizens in the speedy adoption of a simple world-wide uniform standard of weights and measures; Now, therefore, be it

"*Resolved*, That the city council of the city of Chicago respectfully urges that the units of measure of the metric system be adopted by the Congress of the

United States of America and the British Parliament as the exclusive legal standard of weights and measures; and be it further

"*Resolved*, That copies hereof be forwarded to the President of the United States of America (through the Bureau of Standards, Department of Commerce) and the British premier (through the board of trade) and other legislators concerned."

In connection with the foregoing resolution Alderman Olsen presented a communication from the department of weights and measures and moved that said communication be published.

The motion prevailed.

The following is said communication:

DEPARTMENT OF WEIGHTS AND MEASURES,
Chicago, May 18, 1920.

Alderman CHARLES S. EATON,
Chairman Subcommittee of Committee on Judiciary.

DEAR SIR: In reply to your inquiry for the opinion of the department of weights and measures as to the advisability of the city council petitioning Congress to enact a law making the metric system of weights and measures the standard system in the United States, would say that we favor the proposition.

We believe that the metric or decimal system is far better than the present mixed system in use where we have the avoirdupois pound of 7,000 grains, 16 ounces to the pound; the troy pound of 5,760 grains, 12 ounces to the pound; and the apothecaries fluid ounces, etc.

We believe that there should be a uniform system of weights and measures in use throughout the world in order that dealers could intelligently bid for trade in any place without having to go to the trouble and expense of reducing the weights and measures of one country to the equivalent of the weights and measures of their own country, and the expense of making up certain size packages or containers to market their goods for one country that could not be used in other places; and further to make possible the accurate checking up of the different purchases by the purchasers.

We believe that because of the fact that a change from our present system to the proposed system of weights and measures would entail a large expense and would require some time in order that the scale and measure manufacturers could change the scales and measures to comply with the new system, that the law should not go into effect for a certain number of years, and that in the meantime the teaching of the metric system should be made a part of the curriculum of our schools, in order that the children growing up would be familiar with the new order of things.

The metric system is used in this country at the present time in scientific work and also in a number of factories where tools, machinery, etc., are made, and they find it just as easy to use this system as the old one and with a greater degree of accuracy.

Very respectfully, yours,

MORRIS ELLER,
Inspector of Weights and Measures.

Mr. WILLIAMS. And in connection with what Dr. Wiley said, I would like to submit a letter from Mr. P. P. Claxton, Commissioner of Education.

The CHAIRMAN. Very well.

(The letter referred to is as follows:)

DEPARTMENT OF THE INTERIOR,
BUREAU OF EDUCATION,
Washington, June 25, 1920.

Mr. W. MORTIMER CROCKER,
Congress Hall Hotel, Washington, D. C.

MY DEAR MR. CROCKER: The rapid increase of the scientific investigations and industrial investigations of world-wide interest, the expansion of international commerce, and the unification of the interests of the peoples of the world through increased facilities of communication make necessary the general adoption of some one single scientific writing in all countries and adopted as the one standard of measurements in a majority of the countries of the world meets all the requirements of a perfect system of measurements, and will no doubt be adopted sooner or later in all countries.

The adoption of the meter for measuring length, the liter for measuring capacity, and the gram for measuring weight will relieve our schools of the

burdensome task of teaching the unrelated denominate numbers which now consumes so much of the time of the children, and will facilitate commercial calculations.

I should like to see all schools and colleges in America unite in an advocacy of an early adoption of the metric system as our single standard of weights and measures.

Yours, sincerely,

P. P. CLAXTON,
Commissioner of Education.

Mr. WILLIAMS. I would like also to submit copy of a letter from W. S. Benson, written when chairman of the United States Shipping Board.

The CHAIRMAN. Very well.

(The letter referred to is as follows:)

UNITED STATES SHIPPING BOARD,
Washington, August 16, 1920.

Mr. W. MORTIMER CROCKER,
Congress Hall Hotel, Washington, D. C.

MY DEAR MR. CROCKER: Replying to your letter of August 5, regarding the adoption of the metric system, I wish to state that for many years I have been strongly impressed with the fact that, sooner or later, the United States would be compelled to adopt this system, and my experience has only strengthened this conviction.

It is one of those useful and necessary reforms that sooner or later must be adopted in intelligent operations, and the sooner it can be brought about the better.

There is every advantage to be gained by it and nothing to lose. The only reason that I can consider that has operated to prevent its earlier adoption is inability to overcome the mental inertia of those who have to take action in this matter.

Very sincerely, yours,

W. S. BENSON, *Chairman.*

Mr. WILLIAMS. I hope I have emphasized the export part of this matter. As I see it we must take care of our surplus. We have to-day, after the war is over, a surplus of goods in this country, and that surplus must be sold, and we must find a foreign market for them.

(After informal discussion, which the reporter was directed not to record.)

The CHAIRMAN. Have you anything further to place in the record?

Mr. WILLIAMS. Nothing further.

The CHAIRMAN. I thank you for your attendance. We will adjourn until tomorrow morning at 11.

(Whereupon, at 12.45 o'clock p. m., the subcommittee adjourned until tomorrow, Friday, October 28, 1921, at 11 o'clock a. m.)

THE METRIC SYSTEM.

FRIDAY, OCTOBER 28, 1921.

UNITED STATES SENATE,
SUBCOMMITTEE OF THE COMMITTEE ON MANUFACTURES,
Washington, D. C.

The subcommittee met, pursuant to the adjournment of yesterday, at 11 o'clock a. m., Senator Charles L. McNary, presiding.

STATEMENT OF DR. CHARLES L. PARSONS, SECRETARY AMERICAN CHEMICAL SOCIETY.

The CHAIRMAN. Doctor, you are the secretary of the American Chemical Society?

Dr. PARSONS. Yes, sir; secretary of the American Chemical Society.

The CHAIRMAN. Kindly state your name and address, how long you have been secretary of the society, and such general statement as you care to make of your qualifications to testify on this subject.

Dr. PARSONS. Charles L. Parsons, 1709 G Street NW., Washington, D. C. I have been secretary of the American Chemical Society since 1907.

The CHAIRMAN. The subcommittee is conducting a hearing on Senate bill 2267, to fix the metric system as the single standard of weights and measures for the United States. There has been considerable data placed into the record, and the personal observations of intelligent people throughout the country. You are called here to testify this morning, I assume, what the adoption of the metric system means from the standpoint of chemical societies. You may proceed in such way as you think would be of the greatest interest to the public.

I will say to you, as chairman of the subcommittee, that the technical features of the subject have been pretty well developed. If you will speak, as nearly as you can, of the practical side of the matter, with which the committee is a great deal more concerned, I think we will be able to get more of value from your testimony.

Dr. PARSONS. I was informed that you had had considerable testimony in detail as to that feature of the metric system, so I did not plan to go at any great length into the matter along those lines, because I have no desire to cumber the record, nor to add to the work that has already been done.

I represent a very large clientele. We have 15,200 members, chemists, who are thoroughly familiar with the metric system, and they are the one profession that uses the metric system solely in their work. Among our 15,200 members, to the best of my knowledge and belief, there is not a single one opposed to this bill, but they are all in favor of it.

They are in favor of it because they know from years of experience what the metric system means to them, both in the laboratory and out of the laboratory in commerce. They realize there is not any question but that America will be very much better off if she will come to the use of the metric system, as the other civilized countries have done, with the exception of England. They can not understand why America has not done so long before, except for that peculiar characteristic of the Anglo-Saxon race that wants always to do what our forefathers did and what they have been used to, with the exception of the automobile and the oxcart. They prefer the automobile to-day to the old oxcart which they formerly used because of its superiority as a means of transportation; and the metric system is as much of an advance over the system that we have in effect to-day as the automobile is over the oxcart.

I should like to place in the record the following two votes passed by the council of the American Chemical Society. On December 14, 1918, the council of the American Chemical Society unanimously voted—

"That the American Chemical Society heartily favors the universal adoption of the metric system, as far as possible, to the exclusion of all others, and that the committee on foreign chemical trade be requested to use its influence to have the metric system adopted in America's foreign trade in order that this country may compete in foreign countries for trade at least on an equal basis with Germany and other countries that have already adopted this simplest and most perfect system of weights and measures."

On April 12, 1920, the council voted unanimously—

"That in order to promote the cause of metric standardization the American Chemical Society should join heartily with the World Trade Club, of San Francisco, with the American Metric Association, and with the London and Manchester Decimal Association in forming a world metric standardization council, in calling a conference in San Francisco on May 17, 1920, with the object of promoting adoption of the meter-liter-gram system in the United States and throughout the world."

We have always, on all occasions, taken the stand, without one adverse vote, even in our large meetings, where hundreds have been present, in favor of the adoption of the metric system. We take the stand simply because we know from experience what it means. We use it daily. As far as is possible in my own work and in my own mind I forget all other systems. Of course, I still have to buy things daily by the pound, and I weigh myself by the pound, and I still have to think in some of those units, but I wish I did not have to do it. It is forced upon me by conditions in the country.

I have almost the same feeling as I did last summer when, while I was in England, I stepped onto the scales and put an English penny into the slot and saw it go up to 14. When it got to 14 I did not know any more about what it was than I did before, nor, I venture to say, would anyone in this room have known. That meant 14 stone, a unit which they use over there, and which is another one of the old English units which we have forgotten to use. I went and hunted up a book, because I was curious to know whether I was losing weight, as I had hoped to do on going to England, and I found I had gone to 196 from 204. If I had had it in kilograms I would have known how I stood, in England or anywhere else in the world, but unfortunately the English do not use the metric system.

When you speak of the hundredweight there it means 112 pounds, not 100 pounds as it does here. A ton there means 2,240 pounds; here it means 2,000, except when dealers buy at 2,240 pounds and sell to the public at 2,000, as they do in many cases.

Of course our system is very much the same as if we had in this country the moneys of all the world and tried to use them, instead of the one simple decimal system which we do have. And the comparison is absolutely a comparison of that kind. One finds it very hard in England these days to understand how they can still adhere to pounds, shillings, and pence, and all the other things they use, which have no relation one to the other units in decimal numbers. With all the troubles in calculations which they make they adhere to it simply because their forefathers did, exactly as we adhere to these old systems. They have not the same sized quart or gallon as we have. We use more in certain cases because we have adopted some of their subdivisions.

There are so many of these different units which operate against efficiency. It seems so useless. I was called up the other day by some people who had sold a lot of lead arsenite to farmers out in Illinois, the stuff having been brought from England and it was sold by ton. There was a suit brought because in England a ton is 2,240 pounds and in Illinois it meant 2,000 pounds. Each one of them supposed they were buying on the home system. As the price of the material is fairly high per pound, it made some difference which they used. Both were perfectly honest; both of them thought they were dealing squarely.

A similar case arose a short time ago in the sale of gasoline to Australia. You probably know that when you buy crude oil you get some 42 gallons in a barrel. I do not know just what it is. When you take that same barrel and fill it up with gasoline there is something like 52 gallons—about 10 gallons more. So we do not know where we are in trade and commerce. But with this metric system, with its simple decimal relationships, we have no difficulty whatsoever.

The great difficulty with the metric system in America, the reason it has not been adopted to-day, is not due, in my opinion, to any inherent difficulty in the metric system, but in the way we teach it. I have been very, very, much impressed with that in my own experience. I was a professor in the New Hampshire Agricultural College for a number of years, and I used to have to teach the metric system each year to the boys and girls when they came and started in with their freshman chemistry. They had come from the high schools, all of which require the metric system to be taught. But not one of them knew anything about the metric system when they reached college. They could tell me that a meter was thirty-nine and some fraction inches, that a liter was a certain part of a quart, but they knew nothing about the metric system; that is, they had been taught the metric system exactly as if they had been taught United States money by telling them that a dime was 4 pence, half-penny—something of that kind—and they did not know what it was then; as if they had been told that a dollar was 4 shillings, and so on. They were taught in terms of another system, so they had no thought of the system itself. There is the basic difficulty that is preventing the establishment of the system in America.

When I got those boys and girls in the first lecture I always took the first half hour to teach them the metric system. I taught them the metric system in a half hour without any difficulty, and they went on and used it during the rest of their course in college, and have thought in it more or less through their life, simply for the reason that we taught them the metric system and forgot all others.

Take a stick, for example, like this which Mr. Crocker has brought here to-day [indicating]. I do not want to take up your time unnecessarily, Senator. This stick has got these figures on this side [indicating] which ought not to be on it at all; it shows it in inches. They should not be there at all. That is a meter. That is all there is to it. You have to look at it—that is all—just the same as if you were told that is a yard; you look at it and gradually you get used to what it means. That is a meter. That is the basis of the metric system. That is divided into a hundred parts.

The CHAIRMAN. We have had that over and over again.

Dr. PARSONS. And into 10 parts. That is exactly as we divide our dollar. I am sorry this liter measure [indicating] is made round. It ought to be a cubic box, a cubic decimeter.

The CHAIRMAN. You like the other way the better?

Dr. PARSONS. Yes; it is much better. If you simply start with them and learn them, and use those units, you get to think in them. The method is of the utmost simplicity, exactly like the United States money system, and it saves hours and hours of calculation. We do all our chemical work in it; we could not do chemistry without the metric system.

The CHAIRMAN. I have no doubt that is true, and there are certain other branches of human activity where it is very important and which have adopted it because it has been enforced upon them through the desire to apply the best scheme known to economics and to commerce. Does not the law that causes us to adopt that which is most useful apply in this as in other matters?

Dr. PARSONS. No, sir; it is the inertia to change, which is the only reason that we have not adopted it in America. That is a predominant Anglo-Saxon trait.

The CHAIRMAN. That is a human characteristic.

Dr. PARSONS. It is good fortune solely that we have the dollar in this country, that our forefathers at the time this country was founded put in the dollar currency and did away with the English system of money.

The CHAIRMAN. You chemists are using this system?

Dr. PARSONS. Yes, sir.

The CHAIRMAN. You could not get along without it?

Dr. PARSONS. That is true.

The CHAIRMAN. Why do you want to force it upon the great mass of the people? What advantage would that be to you?

Dr. PARSONS. Because, as well as being chemists we are citizens, and we know how much it would mean to us as citizens in our daily work. If I had a tank of water out in my back yard and wanted to find out its contents and weight, and in many other of those occurrences of every-day life, you can do it in your head in the metric system, which you could not do in any other.

Also in the common schools, before I ever studied a word of chemistry, I could have saved at least one-third of the time that was spent in my study of mathematics.

The CHAIRMAN. That is not an answer to the question that I propounded, as I understand it. This is only for the purpose of enlightening the record. What difference does it make to you as a chemist, having adopted it as your standard of weights and measures, that it is not used by a farmer out near Frederick, Md., for instance?

Dr. PARSONS. As chemists it does not make any especial difference to us whether the farmer uses it or not, but as citizens it makes a very great deal of difference, because it is stopping the whole progress of the country, when compared to the progress of the rest of the world, in my opinion. I think it is injuring our foreign trade. During the war a number of our manufacturers took up and used the metric system with perfect ease and found that they could save a great deal of trouble. Already many of them in this country have gone over to it.

The CHAIRMAN. They have the privilege of doing that, of course.

Dr. PARSONS. I know, but they have to buy a large amount of their material from others in these other systems and have to resort to conversion. The whole thing comes down very largely to a question of simplicity. Is it not better to have one system in use, which is the best system in the world, just the same as we have one money? It seems to me your question is exactly the same as if you asked me why as chemists we should want to have one standard American currency, if it was a fact that in this country at the present time we had the currency of practically all the nations of the world floating freely, and in which we had to deal. I should say the answer is apparent immediately to anyone that the country could not help being better off by working in one standard. The conversion to that standard and the use of that standard is very quickly and easily accomplished. The whole country would know it and use it perfectly easy in a week. Therefore the transactions of everybody in the country, the farmer, the manufacturer, and the laboring man, would be greatly simplified.

The CHAIRMAN. Do you think that a standard of weights and measures is more important than a standard of coinage?

Dr. PARSONS. Not of more importance, but of equal importance.

The CHAIRMAN. We have the best system in the world because it is metric?

Dr. PARSONS. In coinage.

The CHAIRMAN. Why does not France, Germany, England, Italy, China, and Japan adopt our coinage system?

Dr. PARSONS. France does have a decimal coinage, and so does Germany. England, however, with its Anglo-Saxon characteristic, has not changed. Personally I am of the hope that this so-called international bank will go through that is proposed by Mr. Vanderlip, and then we will have a dollar currency the world over.

The CHAIRMAN. Do you believe in the provisions of this act which attempts to make it obligatory on the people of the country to adopt it in 10 years?

Dr. PARSONS. I do.

The CHAIRMAN. You do not think it is proceeding fast enough now?

Dr. PARSONS. No. That has been shown very plainly by past experience. We are too subject to the inertia of our race. It is gradually coming. I have not any question whatsoever but what we will ultimately have the metric system and be forced to it by the rest of the world, bu I hate to see the American people be the last in the procession.

The CHAIRMAN. Now, Doctor, is there any record you want to put into the hearing?

Dr. PARSONS. Nothing more than I have. Possibly, however, you might like to have this resolution, passed day before yesterday by the Association of Official Agricultural Chemists.

The CHAIRMAN. That may go in the record.

Dr. PARSONS. They have just met here in Washington. They represent all of the States of the Union, practically, and they passed a resolution which I will read if you desire it.

The CHAIRMAN. That will not be necessary, as it is to go in the record.

Dr. PARSONS. This is the resolution passed by the Association of Agricultural Chemists at their convention held at the Hotel Washington on Wednesday, October 26.

(The resolution referred to is as follows:)

"*Resolved*, That this association indorses the proposal now under consideration by Congress that, after due notice, the metric system of weights and measures be made the legal system of the United States; and, also, to further the introduction of this system, recommends that its members, in the purchase of supplies, designate and describe the same in terms of the metric system so far as possible."

The CHAIRMAN. Is there anything further you want to say, Doctor?

Dr. PARSONS. I think there is nothing further I personally wish to say, unless you have some questions to ask, Senator. I wish that you could use this system yourself a little while. I am sure that we would have in you the most enthusiastic advocate that anyone could wish. It means so much. One can not realize it until they have actually used it.

It seems to me that there is one thing in the bill that might be improved. While I think the 10-year period is quite sufficiently long for the purposes of the bill, I do wish you would make it a shorter period in which to start the use of it by the Government, so as to give the people a little more chance to get familiar with it through the customs houses and the post offices.

The CHAIRMAN. That point has been suggested heretofore by a number, and it is not unreasonable at all, that if this bill should be adopted perhaps the system should be initiated through the action of the Government prior to its enactment into law.

Dr. PARSONS. Speaking of the War and Navy Departments, I have talked with many, many of the officers of the Army and Navy who, having used it abroad, were strongly in favor of its adoption in this country. I think that you will find most of the expeditionary force who have actually used the metric system, officers and men, if they had a vote here to-day would vote overwhelmingly in favor of the adoption of the metric system by America. I feel very confident of that, because I have so far failed to come in contact with one who, having used it, was not in favor of its adoption.

It is the same way with all engineers with whom I have come in contact, who have practiced in foreign countries and have used it. I have recently been in contact with a number of mechanics that have had to use the metric system from foreign drawings, and having once used it they much prefer it. I know a number of works that have taken it over and are using it.

You probably know that the Solvay Co. are using it in all of their works—that is, within the company—but when they come to sell they have to go to pounds to meet the present demands of the American people. It makes a double conversion. I was through another factory recently and found they were making their measurements in metric. In talking to the mechanics, they told me they much preferred it to the old procedure. In all our works they have abandoned the use of a fraction of an inch in the smaller dimensions and are using the tenths, hundredths, and thousandths of an inch.

The CHAIRMAN. Doctor, I thank you very much for your testimony. The committee will make good use of it. When the hearings are printed, if you want copies of them we will be very glad to supply them.

Dr. PARSONS. Thank you very much. If I may, I would like to call attention to one other thing which I have neglected to mention. It will take me just a moment.

The CHAIRMAN. Very well.

Dr. PARSONS. The Chemical Society has felt recently we ought to clean house a little bit ourselves. We found that some of the chemical manufacturers were putting out some chemicals in pound packages and ounce packages. We have written during the last year or two to many of these and to our colleges and universities, and practically all of the colleges and universities now have agreed, some 200 of them, to order all of their chemical apparatus and all of their chemicals in metric units only. And a number of manufacturers have agreed to put out their chemicals in metric packages only.

I would like to call your attention to one little pamphlet that is just out, published by the Powers-Weightman-Rosengarten Co., of Philadelphia. It is done so very nicely. You will notice it is a very neat little catalogue of their chemicals, and not anywhere in it would you have any knowledge there was any system in the world except the metric system. A number of other chemical manufacturers are doing the same.

STATEMENT OF MR. H. W. BEARCE, BUREAU OF STANDARDS.

The CHAIRMAN. Mr. Bearce, you are from the Division of Weights and Measures of the Bureau of Standards?

Mr. BEARCE. Yes, sir.

The CHAIRMAN. Have you some record that you want to put in the hearings?

Mr. BEARCE. I have some notes which I might use in speaking.

The CHAIRMAN. Are they in shape to be placed in the record, and thus save time?

Mr. BEARCE. I should be quite willing to simply submit them for the record.

The CHAIRMAN. I have examined your notes, Mr. Bearce, and I believe they are in shape to be made a part of the record, and that they will be found to be very illuminating to the committee. Is not that in as good form as you want it?

Mr. BEARCE. I think it is probably in more logical and consecutive arrangement than I would give it orally.

The CHAIRMAN. This may go in the record. It touches some very practical sides of this matter.

Mr. BEARCE. The points I have noted there are the points as they appealed to me, that will come about from the passage of this particular bill. It has seemed to me in listening to much of the testimony that there is a good deal of misapprehension as to just what is contemplated by the bill. Much of the discussion, as the chairman has often pointed out, is not relevant to the bill. If we are to act intelligently on this bill we ought to take especial care to see that we know what is in the bill, and hold the discussion to those points covered by the bill.

That is what I have attempted to do in the notes I have prepared. I raise some questions there which are not entirely clear in my mind, which I have no doubt are clear in the minds of the committee.

The CHAIRMAN. Are there any provisions in this measure which you think should be modified, or that new provisions should be inserted; or do you think that the bill in its present form should be adopted?

Mr. BEARCE. I am rather favorably disposed toward the suggestion that has already been made to have this time considerably shortened with reference to the Government; that is, have the bill apply to all transactions of the Government within a shorter period, possibly a year or two years, as a means of education. It is primarily a problem in education. The only object of this bill, or any other bill, as far as I can see, is as an aid in the educational process. If we can aid better in the process by having the Government begin to use it to-morrow or next year, let us do it that way.

I believe it would aid materially. It would give the necessary stimulus and incentive to the States to so modify their educational systems that the process of education would be facilitated. If the young people growing up become more familiar with the system than they have in the past, they will be more ready to use it, they will be better qualified to use it.

From that standpoint I believe that it would be of decided advantage to inaugurate this change on the part of the Government within a shorter period. If it is made 10 years most of the change would come in the last year, I should suspect.

One point has been made that seems to me might be amplified a little. That is, the question has been asked if the metric system is of so great advantage to the industries, why don't they go ahead and adopt it and use it of their own initiative? I believe the answer to that is that no one manufacturer, no one industry, can effectively do that. He is hedged about by the actions of his neighbors.

Now, as to myself, as a citizen, however much I might want to use the metric system I can not go into a dry goods store and buy cloth by the meter, I can not go into the grocery store and buy meat by the kilogram, because they do not have the equipment; they are not doing business that way.

The CHAIRMAN. You are putting yourself now in the position of the consumer, a member of the general public. You were speaking about industries, but you are not on that subject at all. Now, as has already been said, the chemists, for instance, have adopted this system for all of their work.

Mr. BEARCE. Within the industry; that is, within the scientific, technical industry.

The CHAIRMAN. It is like the builder of locomotives, of automobiles, of gas engines or what not. He finds it advantageous to him, he finds it more

efficient and economical, that better results are obtained by the workmen, that by reason of its simplicity they take it up easily and can work with it successfully. I can appreciate that phase of it. But to be able to go to the consumer, or to the grocer on the corner and compel him to sell to you in the metric system, that is not, in my opinion, what makes it valuable.

Mr. BEARCE. The manufacturer of chemical products, for example, of industrial alcohol, however much he may desire to use the system in his factory, in his plant, in his laboratories, can not use it completely, because he is obliged to sell by the gallon, he is obliged to ship by the ton; he is obliged to pay his freight on the ton basis. For that very reason he must at some point, even though he uses it completely in his industry, make the conversion because of the relation he necessarily holds with other industries.

I think, Mr. Chairman, that most of the points I would care to make are covered in the brief I have submitted.

The CHAIRMAN. I think they are, and most intelligently presented. I am glad to see that you refer to the matter which has been brought up by the chairman, concerning what it does to the agriculturalist, to the man who is a salaried employee, to the great consuming public. You seem to go into that somewhat.

Mr. BEARCE. I have touched some of those points.

The CHAIRMAN. I thank you for your paper and your brief review, Mr. Bearce. You will be in attendance at the remainder of the hearings, I presume.

Mr. BEARCE. Yes; I shall be glad to.

(The prepared statement by Mr. Bearce is here printed in full, as follows:)

"Before discussing the bill in detail I should like to make sure that I understand just what is contained in it. This would seem to be a necessary prerequisite to an intelligent discussion of what may reasonably be expected to result from its passage.

"In the discussions of the bill that have been presented during these hearings it has seemed to me that certain assumptions have been made that are not at all justified. Meanings and actions have been read into the bill that are in no sense contemplated by the bill, and in order that I may not fall into the same error I am anxious to have these points made clear.

"My understanding of the bill is that it does the following things:

"Section 2 specifically adopts the national representations of the international standards of the metric system as the fundamental standards of weights and measures of the United States.

"Section 3 makes it unlawful to sell any goods, wares, or merchandise or to charge or collect for the carriage or transportation of any goods, wares, or merchandise except in terms of the units of the metric system.

"Section 4 makes it unlawful after 10 years from the date of the passage of the bill to use in any of the transactions detailed in section 3 any weight or measure or weighing or measuring device designed, constructed, marked, or graduated in any other system than the metric system of weights and measures.

"Section 5 makes the bill apply to postage, excises, duties, and customs.

"Section 6 provides for the promulgation of rules and regulations for the enforcement of the act.

"Section 7 provides for the repeal of such acts or parts of acts as are inconsistent with this bill and for the substitution of metric equivalents for certain values now given in terms of the customary units.

"Section 8 makes certain exceptions as to the application of the bill. For example, tools, machines, and other appliances may be designed and constructed in terms of any desired system; goods, wares, and merchandise intended for sale in a foreign country may be manufactured, marked, and sold in any desired units.

"Those, I believe, are the principal features of the bill.

"One point on which the bill is not entirely clear to me is whether or not the measurement of land is included under the bill. When land is sold by linear or superficial measurement, must it be sold in units of the metric system? From the legal and technical definitions of 'goods, wares, and merchandise,' I take it that the sale of land, or other real estate is not included under this bill, but there might be a question in the minds of those not conversant with strict definitions. I suspect that the general impression of the layman on reading the bill would be that the measurement and sale of land is included in the bill.

"Another point on which I am in doubt is whether under this bill it would be lawful to buy products manufactured in customary units. For example, would it be lawful to buy a seven-eighths inch by 18 thread spark plug, a one-half

inch by 13 thread bolt, or a length of 2-inch shafting? It is my understanding that such transactions would be lawful provided the sale is on the basis of numerical count, that is, by the piece, or if when sold by weight or measure the units employed are the metric units. For example, it would be lawful to buy 2-inch shafting by the meter, or by the kilogram, but it would be unlawful to buy it by the foot or by the pound.

"That is a very important point and should be made clear if it is not already clear.

"I shall not dwell upon the advantages of the metric system to the scientist: these advantages are recognized by all. Science will continue to use the system whether this bill passes or not. The real question is, therefore, not what will be the effect of the bill upon the scientist but what will be the effect upon the farmer, the merchant, the manufacturer, the housewife, and all the rest who are not already using the metric system. If the metric system actually has the advantages that it is asserted and admitted to have when used in science, it would seem reasonable to suppose that these advantages would also be found when the system is applied in other walks of life. The scientist is not greatly different from other people, and the problems of the scientist are solved by the same rules that apply to the problems of other people. If these advantages can not be shown except in the field of science, then there is something seriously wrong either with the system or with the methods and arguments used in presenting the case.

"First it might be well to inquire why the metric system has any advantage, in science or anywhere else, over the English or customary units. The obvious answer is, because of the simple interrelation of its units. That is, the units of length, area, volume, weight, density, etc., bear simple relations to each other such that calculations involving these units are very much simplified. Each unit is also decimally subdivided and decimally multiplied, so that to change to a larger or smaller unit it is only necessary to change the position of the decimal point. Furthermore, in the metric system the same name always means the same thing, whereas in our customary system there is confusion as to certain units; the quart, liquid and dry; the ounce, avoirdupois, troy, and fluid; the ton, long and short.

"It is sometimes claimed that the same might also be done with our customary units, with the same advantage. That may be true, but the fact remains that it has not been done except in a very few cases. The barrel of 52 gallons might be subdivided into tenths, hundredths, thousandths, etc., but it isn't; it is divided into gallons, liquid quarts, pints, gills, and fluid ounces. The bushel might be subdivided into tenths, hundredths, thousandths, etc., but it isn't: it is divided into pecks, dry quarts, dry pints, and cubic inches.

"The chairman has asked for examples to show where the farmer would be benefited by the adoption of the metric system. The advantage to the farmer will depend largely upon the type of farmer we have in mind. If the farmer sells so much wheat at so much per unit of measure, or so much beef at so much per unit of weight, and simply wants to know how much money he will get for the quantity sold, then one system is about as good as the other; it is a problem in multiplication in either case. On the other hand, if the farmer is running a real business on a real business basis he will want to know not only what he gets for his wheat and his beef but also what it has cost him. He also wants to know the cost and returns from his other farm products.

"Take the case of the dairy farmer: If he is running his farm on an intelligent basis he must know the cost as well as the selling price of his product. To determine this cost requires more calculation than many problems in so-called 'science.' The hay must be valued at so much per ton, and fed out at a rate of so many pounds per cow per day; the cottonseed meal is purchased by the ton and fed out by the quart; the ensilage is raised by the acre, on fertilizer bought by the ton, and fed out at the rate of so many pounds per cow per day. Of the milk, a part is sold as whole milk, at so much per quart; a part is run through the separator, and the cream sold on the basis of the fat content at so much per pound of butter fat, the fat content being determined on an 18-gram sample, while of the skim milk, a part is sold at so much per 100 pounds, while a part is fed to pigs and calves which are afterwards sold by the pound. The farmer who strives to work out problems of that kind and tell whether he is making money or losing it is as much entitled to a simple system of weights and measures as is the scientist, and has just as great need for it.

"Did you ever wonder why it is that the boys of the corn clubs and pig clubs, around over the country, are raising better pigs at less cost and more corn per acre than their fathers ever raised? How do they do it? They do it by using a better system than their fathers used. It is not because they are instinctively any better farmers, but because they select better stock and better seed; because they prepare their feed and fertilizer in better proportions, and feed it and apply it in correct quantities. In other words, because they weigh and measure where their fathers guessed.

"As this weighing and measuring continues and increases among the coming generations of farmers, these young men are not going to be content to struggle along with an antiquated and cumbersome system. Many of them are already familiar with the metric system from using it in the Babcock test of milk and cream and in soil and fertilizer analyses. To these young men the complete adoption of the metric system would be an easy step gladly taken.

"It is the same in other industries. A case recently came to my attention which I believe is typical. In the denaturing of ethyl alcohol for use in the industries it is customary to carry out all laboratory operations in terms of metric units, while in the plant itself the various operations are carried out in pounds, ounces, gallons, etc. This double system makes it continually necessary to convert from one system to the other in order that the results may be intelligible in the plant and in the laboratory. If all analyses, mixing, weighing, sampling, and selling could be carried out in the same system a great deal of troublesome calculation and a good many mistakes would be avoided.

"In attempting to show the advantage of the metric system to the ordinary purchaser of dry goods, groceries, etc., for household use I shall give just one or two samples. When you stop at the meat market and buy a steak for dinner, how often do you feel sure you are getting all you pay for? Suppose the steak weighs 1 pound 13 ounces and the price is 47 cents a pound, can you tell without a pencil and paper how much you ought to pay? When your wife buys 5¾ yards of dress goods at $1.98 a yard, does she get her change as quickly and as accurately as she should?

"In attempting to judge the relative value of goods offered for sale we are often confused by the variety of markings appearing on containers. One bottle may be marked '1 quart,' a second '28½ fluid ounces,' and a third '1 pound 15 ounces.' With a different price for each bottle, it is not easy to determine which bottle is the best to buy.

"Another example that occurs to me as showing the advantage of the metric system over our customary system is in the inspection of commercial weighing and measuring apparatus for accuracy. Suppose the scale inspector finds a certain scale on which the grocer is weighing sugar to be in error 1 pound 3 ounces 200 grains on a 50-pound load, what is the percentage of error?

"The measured shortage on the delivery of a gasoline measuring pump offers the same difficulty. The pump delivers in gallons, but the error can not be measured directly in gallons, but must be measured in fluid ounces, cubic inches, or cubic centimeters and then converted into gallons.

"In considering specifications for weighing and measuring apparatus it is customary to rule out any device which readily 'lends itself to the perpetration of fraud.' If weights and measures systems were judged on the same basis, our customary system would certainly have to be stamped 'Not legal in trade.' It is no more suited to our day and methods of doing business than is the English money system of pounds, shillings, and pence.

"I can see very little advantage to anyone in the bill as drawn. The objectionable features of the bills formerly introduced have been removed, and I don't see how very much objection can be raised to it. The bill would require certain replacements or changes in weighing and measuring apparatus, and I do not believe that would be a serious matter. Within the 10 years provided much of the weighing and measuring apparatus now in use will be worn out and replaced in the natural course of business, and only that remaining will need to be altered or replaced.

"I am therefore of the opinion that the bill should pass, and that its passage would be a distinct advantage to the country as a whole.

"The complete adoption of the metric system is, I believe, inevitable, but it can come only through education. Dr. Parsons has put the case well; and the chief benefit of this bill, or any other similar bill, is as an aid in this process of education. When the majority of the people of the country believe that the

exclusive use of the metric system is to their advantage they will voluntarily adopt and use it. This bill would, I believe, very much facilitate the adoption and shorten the time required by making those who are inclined to lag behind the procession keep in line and keep up with the general progress."

Mr. CROCKER. I have here two papers, which are very brief, which I would like to submit as testimony from two men who have given this question consideration and made a profound study of it. These men would both be here to testify, but in view of the long distance between San Francisco and Washington they are unable to appear.

With your permission, I would like to insert in the record as testimony the statement of Mr. Ben C. Dailey, president of the World Trade Club, of San Francisco, and the statement of Mr. Aubrey Drury, the secretary and treasurer of that organization.

The CHAIRMAN. Very well; they may be inserted in the record.

(The papers referred to are as follows:)

TESTIMONY OF BEN C. DAILEY ON THE LADD METRIC BILL (S. 2267).

In view of the widespread interest in the World Armament Conference in Washington, D. C., it is well to consider the close relation of national defense with world standardization of weights and measures.

On every hand it is emphasized that the conference is not one of disarmament, but rather one leading to limitation of armament. Nations will be called upon to reduce their tangible armament equipment. Naturally they can not be called upon to dispense with those methods of standardized production, and of coordination of industrial effort, which prove of such tremendous efficiency value in modern warfare as well as in time of peace. Nations will perhaps reduce the volume of war material, but they will scarcely do away with the methods making possible the mass production of war material and supplies—capable of quick expansion in case of emergency.

The United States is fairly well equipped for individualistic effort in warfare—but experience has shown it sadly lacking in capacity quickly to coordinate its effort with that of other nations in the event of world war. This is a glaring defect in our national defense, and no matter what may be the result of the armament conference, ought to be corrected by the United States forthwith. If we are to reduce our tangible preparedness (guns, munitions, battleships, fortifications, and so on), the more reason why we should secure the best possible intangible preparedness—world metric standardization, which will make quickly effective our effort to act jointly with the other nations of the world if we are called upon again to defend world civilization. We may be sure that virtually all other nations will be equipped with metric standardization, this agency of modern preparedness; and for us not to possess ourselves of it will leave us greatly at a disadvantage. The peril of our situation was disclosed by the World War.

When the United States entered the World War our isolation in the essential matter of weights and measures became fully revealed. Because of lack of units standardized with those of any other nation we were not able at once to aid our 28 allies which were on the metric basis. America and Britain discovered with a shock that they were not even standardized one with the other. Upon every hand we found ourselves hampered and delayed by this tragic lack of uniformity.

War is the supreme test of efficiency. To gain utmost efficiency in warfare the United States was obliged to adopt the metric units for military purposes—just as Britain likewise had done in 1914. To attain interchangeability of ammunition with the French and other allies in 1917 we adopted the famous 75-millimeter gun as our basic artillery weapon, supplemented by the 155 and 240 millimeter guns and howitzers. United States American War Department order No. 1, issued January 2, 1918, declared: "The metric system has been adopted for use in France for all firing data for artillery and machine guns, in the preparation of operation orders, and in map construction." Virtually the same order went out to Army training camps throughout the United States. This made the use of the metric units in warfare virtually unanimous, and may truly be termed one of the great victories of the World War.

Let it be recognized, however, that this belated transition to the metric standards by Americans and British in the midst of war's turmoil involved tremendous unnecessary losses. True, preparedness would have led us to world standardization long before the war. The enemy, Germany, had been standardized on metric units since 1871. Thus Germany was able to coordinate all parts of her mechanical system, her production of war equipment and

material—and in Germany everything was war material. Because of these standardized units Germany from the outset found it easy to work in concert with Austria, Hungary, Bulgaria, and Turkey, which all had absolute military standardization on the metric basis. Here was a vast advantage of the Central Powers over their adversaries—an advantage on which they had fully reckoned in launching the World War. Some observers, indeed, believe that the Kaiser would never have dared to declare war if his potential opponents had possessed such standardization of munitions and supplies. When we realize the gigantic military efficiency gained by Germany through using metric units while its enemies were handicapped with a diversity of units we may well direct our attention to the charge made by investigators of German world propaganda that the Kaiser long before 1914 had sent out the command to German secret agents everywhere, "Hold Britain and America unstandardized at any cost until after Germany's next war."

We have seen that the United States of America, when actually engaged in the war, hastily took up the metric standards to gain military efficiency. This move, wise though it was, came too late to save the Nation and the world from vast losses which would have been avoided had we in earlier years taken up metric units as a measure of preparedness. The hasty war-time transition to metric munitions involved inevitable confusion and delay, and it was upon these that the Germans had calculated. Ample evidence of this wastage of time and effort is presented in the monumental report, "America's Munitions," by Benedict Crowell, Assistant Secretary of War and Director of Munitions. He declares: "Weeks and even months of time on the part of whole staffs of experts working at high tension were consumed in translating French (metric) designs into terms of standard American shop practice during the World War." To-day Benedict Crowell is president of the American Army Ordnance Association.

Another noted authority, F. O. Wells, long president of the Greenfield Tap & Die Co.—a concern manufacturing many things indispensable to the supply of war munitions—has been quoted as saying that the World War was lengthened two years through lack of thorough metric standardization amongst the Allies. Benedict Crowell and other experts infer the loss of at least several months because of such faulty coordination.

Suppose that for this reason the war was lengthened only two months; what does that mean? It means this: During every month of the World War 100,000 men were killed, 200,000 were wounded or missing. Thus two months' delay meant the needless killing of 200,000 men, the needless maiming of 400,000 more. Thus were thousands of brave warriors "linked irrevocably with the past," when they might be here with us to-day in the present, if the United States had possessed the "gumption" to scrap the obsolete standards with which it has long been encumbered and to take up instead the logical metric units adapted to modern world conditions.

As a result of these lessons of the World War, Gen. John J. Pershing recommends the continued use of metric units by the United States for military purposes and for all other purposes. "The experience of the American Expeditionary Forces in France," he declares, "showed that Americans were able readily to change from our existing weights and measures to the metric system. I believe it would be very desirable to extend the use of the metric system in the United States to the greatest possible extent." Such is the opinion of our eminent Chief of Staff. His recommendation has been supported by Marshal Joffre, Marshal Petain, and Gen. Nivelle, all of whom have earnestly requested the United States to heed the teachings of the war upon this vital point. True military preparedness can be secured, declare these leaders, only when the United States employs the standard world units, so that it may instantly and at all times cooperate with the armed forces of other nations. Only so can it provide against needless losses in possible world war.

It is significant, as showing the future policy of our Army, that the 75, the 105, the 155, and the 240 millimeter guns have all been retained. Extensive use of metric standards is to-day a realized fact in American Army ordnance—and the "metric munitions" have come to stay.

Testimony to this effect is contained in an apt article on "Modern Preparedness," by Benedict Crowell, in the September (1921) issue of The Nation's Business. His tabulation shows that virtually all the great cannon which our munitions factories are equipped to turn out in the future are of metric caliber. Mr. Crowell wisely cautions our people not to relinquish advantages of equipment attained during the recent conflict. He deplores the fact that "after every

war the United States has slumped from a peak of fighting efficiency to something near zero in preparedness."

The Ladd bill now before the United States Senate (S. 2267) ought to be passed as a measure to increase our national efficiency. Above all, it should be enacted as a measure of necessary national defense, for it will go far toward putting the United States on a unified basis with the nations of the world in supply and coordination of war material.

While all true Americans should devoutly hope and pray for the future peace of mankind, until some definite disarmament settlement is reached, surely it appears the part of wisdom to be ready to meet any possible crisis that may confront us. The world to-day is full of military rivalries and gigantic trade competition, full of suspicion and unsettled disputes between nations. For our own safety, as long as this condition prevails, we are in duty bound to be equipped with modern preparedness at least equal to that of potential rivals. And modern preparedness involves standardization with the world.

Testimony of Aubrey Drury on the Ladd Metric Bill (S. 2267).

METRIC UNITS IN THE WORLD TO-DAY.

One of the most potent urges to swift acceptance of the metric units by the lagging English-speaking nations has been the news of the final and complete adoption of the metric units by the Empire of Japan, 1921. The alert Japanese have acted with characteristic energy and decision. To them metrics are already familiar, for these units have been employed exclusively by Japan in military affairs since 1871, the year Germany adopted them. The facts are significant. Keen students of world affairs have seen in this complete adoption of the metric system by Japan the securing of a powerful weapon, which is sure to be an important trade factor and which might in the future be used for militaristic purposes as well, just as Germany used metric standardization greatly to its own advantage in the World War of 1914–1918. One watchful observer points out that "the three most troublesome nations," as he calls them—Germany, Russia, and Japan—are now upon the common basis of the metric standards, and he declares that this fact will have its bearing upon future world affairs. Certainly it is a situation meriting the closest attention of the United States of America.

The fact appears, in the case of Japan and other nations likewise, that metric standardization is modern preparedness for either world warfare or world commerce. Considering how largely mass production and supply enter into modern war, the importance of permanent industrial coordination is self-evident. World war and world trade are, in truth, only different phases of the competition between nations. But in war the test of efficiency is fiercer—ancient equipment goes down inevitably before the modern—faulty coordination shows forth as a glaring weakness, for it means the needless slaying of thousands of men. Neglect is paid for in blood. In the struggle for world trade, however, the weaknesses of national organization are often perceived by those most concerned, but not always by the people as a unit. Yet war's bitter teachings are not allowed to pass unheeded by the wise nations of the earth.

All this is admirably summarized in an article on "Standardization," by Waldon Fawcett, in the October (1921) issue of Pacific Ports, a leading world-trade magazine. He says: "The trend to standardize in industry is really a world-wide manifestation. Unmistakably it is an outgrowth of the war, and a logical outgrowth. As a matter of fact, this latter-day ideal of standardization was born of war-time necessity. It was dictated by two considerations: First was the necessity of conserving and concentrating manufacturing and productive resources in the countries organized for war. Second was the requirement for interchangeability of military supplies and equipment that were to be used by allied forces operating simultaneously on a far-flung battle line. It is worth while noting that the lessons that the war brought of the need and advantage of (world) standardization were the same, though on a larger scale, that had been set before a limited share of the world's population for lo these many years."

Largely due to the effects of the World War, the position of the United States in reference to exterior commerce has undergone a fundamental change. More than ever we have become dependent for national prosperity upon world trade. We can not get along without it. During the course of the war we became possessed of world markets, and to meet their needs expanded the output facili-

ties of our factories and vastly increased the production of our farmlands. Now, unless we are willing to face retrenchment and take tremendous loss on every hand we must sell abroad. In the face of the keenest trade competition the world has ever known we are bound to utilize all the efficient time-saving, labor-saving methods developed by moderns. We can not afford to try to "muddle along" with Stone Age tools of trade which most progressive peoples were wise enough to scrap long ago. The race is to the swift, not to the laggard.

How pitiful is it then to hear obstructionists prate about the "cost" of making the gradual transition to metric units when blind retention of the present clutter of weights and measures is contributing largely to the loss of millions of dollars in profitable trade.

Upon this point, what better authority could be cited than a governmental Secretary of Commerce of the United States? The eminent men holding this position have been unanimous in urging world standardization for our country. William C. Redfield, for seven years United States Secretary of Commerce and two times president of the American Manufacturers' Export Association, significantly states: "If we want to throw the business of the United States into the hands of a Germany of the future, into the hands of the French steel and iron manufacturers; if we wish to develop the business of Italy, Holland, Denmark, and Spain, we can do it perfectly well and build up the business of those countries at the expense of our own by confining ourselves to feet and inches, which do not work well in other countries and which the world will not have. We may just as well get ready to adjust ourselves to the great world by making this advance to the metric standards."

Germany is not now engaged in military aggression; but because of that very fact (as Senator Borah has well shown) its attention is concentrated the more strongly upon dominance in world trade. Equipped with the "world language of quantity"—meter-liter-gram—Germany is besting the English-speaking peoples in the choicest commercial fields, partly because they refuse to scrap their obsolete, incomprehensible quantity units. Surely, and not slowly, this aggressive trading nation is wresting from us the rich markets of Latin America once thrown to us by fortune of war.

Dr. W. E. Aughinbaugh, world trade editor of the New York Commercial, in an editorial in that journal on August 6, 1921, declared: "An order for oilcloth totaling $100,000, from the Argentine, has just been placed with a German firm because the American manufacturers in this line refused to make the goods according to the metric system. Oilcloth made in feet and inches means a waste and inconvenience to the Latin-American, a fact which our producers fail to recognize and which costs us millions of dollars worth of business annually."

John Lind, at one time President Wilson's special representative in Mexico, writes: "We must get into line with the commercial world in the matter of weights and measures. I asked an intelligent German merchant in Vera Cruz one day to explain to me how it had come about that Germany had absorbed so much of the trade that at one time went to England. He reached into a drawer, pulled out an invoice from England, and said: 'Do you see those denominations of yards, feet, and inches, gallons and pints, pounds, 2 kinds of ounces, grains, and pennyweights, the whole summed up in pounds, shillings, and pence? Well,' he continued, 'a Mexican, even if he can read a little English, needs an interpreter and an accountant to put this into the language of civilization. That is why we get the business.'"

If space allowed, the instances cited by these eminent authorities could be supplemented by 1,000 similar examples. Lost orders are difficult to trace—of many other thousands thus "passed up" we never learn. Nor can we know the full amount of wastage arising from the numberless errors and the loss of time arising out of the translations and transpositions into and out of the metric units, now necessary in exterior commerce because we are not yet on the world metric basis. But we do know that all this avoidable loss to the United States in world trade must, indeed, run into tremendous figures.

This loss of national income, this falling off in our world trade through lack of true efficiency, is particularly deplorable in times of slack business. It means that factories that ought to be selling abroad are closing down and turning away their workers. The millions of dollars we are thus losing annually would mean prosperity to hundreds of thousands of Americans.

The fact is, Germany is getting the business, Japan is getting the business. We are getting left.

What wonder that the chairman of the United States Shipping Board, seeing the Nation's ships by the hundreds laid up idle in the mud flats of our harbors, and wishing to do his utmost to promote our overseas commerce, has come out strongly for prompt adoption of world standards by the United States. Hon. A. W. Lasker on July 7, 1921, declared: "The metric system is, in my opinion, necessary and must be adopted by the United States within the future in order that our business operations may be conducted in an intelligent way, and I feel that the sooner its adoption is brought about in this country the better it will be for the country."

Since the World War conditions have indeed changed. There is now another vastly important financial reason why Americans must place prime importance upon world trade and the methods for its upbuilding. In former years we had only a negligible merchant marine. To-day we have a great carrier fleet that has cost American taxpayers $3,000,000,000; and in order to save our people from impending monetary loss, we are obliged to find permanent employment for that fleet. In the opinion of Chairman Lasker, one of the best ways to hold the business we have and to secure large and profitable cargoes is adoption of the world standards forthwith. Such also was the publicly-announced opinion of his predecessors as chairman—Admiral W. S. Benson and John Barton Payne. Thus metric standardization has been strongly urged by three leaders of the greatest corporation in the world to-day—the United States Shipping Board.

World traders as a unit want the United States to go onto the metric basis, for upon that basis to-day are conducted the majority of the world's business transactions; and this will be increasingly so in the future. Already in this volume we have surveyed the world-wide advance to metric standardization. All civilized peoples have accepted the world units as their standards with the exception of the American and the British. While these two people lag behind, 40 important nations have progressed to the metric system. Including colonial dependencies, more than 200 countries are now merchandising on the basis of meter-liter-gram. The population of the countries employing these simple metric units outnumbers those using the diverse "British" units at least 4 to 1, and the ratio is being steadily increased.

The metric system is now accepted as the standard by all of continental Europe—more than 400,000,000 people. In Africa, it is found in the vast colonial possessions of France, Belgium, Portugal, Italy, and Spain. All Latin America, from the Rio Grande to Cape Horn, has unified for trade on the metric standards. Official surveys by consular officers of both the United States and Great Britain are conclusive on this point: The metric system is predominant in South America, Central America, and the West Indies. The director-general of the Pan-American Union, Hon. L. S. Rowe, is an advocate of prompt adoption by the United States of these world-recognized standards. His predecessor, Hon. John Barrett, is likewise an ardent worker for exclusive use of metric units. These experts know the facts. They realize that Pan-America, in the future, is destined to transact all its business on the unified basis of meter-liter-gram.

Reference has been made to the adoption of the metric system by Japan. That is another fact of far-reaching significance. It establishes definitely that the future trade of the Pacific will be upon the metric basis. Japan dominates the Far East, and has direct control over more than 100,000,000 people. China also is gradually advancing to the metric units, which are now widely used in commerce (especially at the treaty ports), on the railroads, in the Army, and so on. In Java and the other Dutch East Indies the metric system is officially established, as it is in Siberia, Siam, the Philippines and French Indo-China. Everywhere in the populous Orient the metric system is coming into more exclusive use.

Obviously, the future commerce of the Pacific will be transacted in metric units. It is recognition of this fact that has impelled scores of commercial organizations up and down our Pacific coast to petition Congress to hasten metric legislation; it is one main reason why the World Trade Club of San Francisco has taken a leading part in the metric campaign. Honolulu and Manila are two of our "listening posts" in the Orient; and no sooner had Japan announced its final advance to metrics than the Honolulu Chamber of Commerce went on record unanimously in favor of the Britten-Ladd bill establishing the metric system for American trade, and the Philippine Chamber of Commerce took like action. The largest chamber of commerce in the world—[illegible] in Los Angeles—has entered actively into the campaign to "make America [illegible]."

Perceiving that the trade of the Pacific and of all the world is to be on the metric basis, both legislative houses in Australia and New Zealand passed strong resolutions calling upon the British Imperial Conference to establish the decimal system of weights and measures throughout all lands under the British flag. It is a fact that every important self-governing colony within the "British league" (as Gen. Jan Smuts calls it) has officially expressed a desire for metric standardization and has petitioned the "home government" to act. The conference of prime ministers of the self-governing colonies, and the dominions royal commission wherein all these are represented, have urged a unified advance to the metric system.

In view of all this, the trend toward adoption of the world standard units by the British commonwealths is undeniable. Truly, as Andrew Carnegie said, "this is one of the steps forward that the Anglo-Saxon race is bound to take." And it is bound to be made by the British in the near future. Shall we not lead the way for them? Or shall we lag along at the very end of the procession, as they have lagged in clinging to pounds, shillings, and pence when all the rest of the world has advanced to decimal coinage?

It is virtually certain that if the United States should move toward adoption of metrics; Britain also would move—just as Canada already has followed us in adoption of decimal coinage. But if Britain did not forthwith advance to metrics, it would then find itself truly isolated in the matter of weights and measures—all other trading peoples using the recognized world standards.

But Britain, too, will advance—and all the British commonwealths likewise. Their future prosperity rests so intimately upon world trade that no longer can they tolerate obsolete trade methods rejected by all other civilized peoples.

The world-wide trend to metric standardization has been surveyed, and it has been seen that everywhere the logical decimal units are gaining ground—and antique local units are everywhere going down into the dark oblivion they deserve. Now, the metric system is about to fulfill its manifest destiny. Before many years, it will be employed by all civilized humankind.

The Ladd metric bill should be enacted into law in order to hasten the progress of the United States in securing world uniformity.

Mr. CROCKER. In a word, for the benefit of the record, I would like to say that the World Trade Club, notwithstanding the scathing attack made on it by Mr. S. S. Dale, who sat across the table here and took notes until he told you who he was, and then apparently has decided to appear later as a star witness for the opposition——

Mr. WILSON. I object to the gentleman getting over on our side of the fence in this manner.

The CHAIRMAN. What were you about to say?

Mr. CROCKER. This club is known as the Foreign Trade Club, except for the work of the World Trade Club. I just wanted to read you why the World Trade Club had used that name, because that will come up later on, I am sure, Senator. And in view of the fact that these gentlemen, whose statements I have submitted, are officers of this organization——

The CHAIRMAN. Let me see the document you have there; what is it?

Mr. CROCKER. This explains the function of the Foreign Trade Club, Senator, and what I wanted especially to show was the reason for the Foreign Trade Club using the name of the World Trade Club. This explains just what I wanted to say in just a few brief words, to show you that it is a virile organization functioning at San Francisco, with 450 members, comprising the leading manufacturers, exporters, importers, and merchants on the Bay of San Francisco.

The CHAIRMAN. In order to characterize the club the reporter will insert that phase of this leaflet.

Mr. CROCKER. Thank you.

(The extract referred to is as follows:)

"Believing that world standardization of weights and measures is essential to the future greatest development of American trade abroad, this organization has taken a leading part in behalf of the decimal metric units. Since the campaign is international in character, the name World Trade Club has been used."

The CHAIRMAN. That seems to be all for to-day. We will adjourn until next Monday at 2 o'clock.

(Whereupon, at 11.45 o'clock a. m., the subcommittee adjourned until Monday, October 31, 1921, at 2 o'clock p. m.)

THE METRIC SYSTEM.

MONDAY, OCTOBER 31, 1921.

UNITED STATES SENATE,
SUBCOMMITTEE OF THE COMMITTEE ON MANUFACTURES,
Washington, D. C.

The subcommittee met, pursuant to the adjournment of Friday, October 28, 1921, at 2 o'clock p. m., in the committee room, Capitol, Senator Charles L. McNary presiding.

Present: Senator Ladd.

STATEMENT OF MR. GASTON GIRAUD, COMMERCIAL ATTACHÉ FOR FRENCH INDO-CHINA IN THE UNITED STATES, SAN FRANCISCO, CALIF.

Senator LADD. Senator McNary is engaged on the floor at the present time, and will be unable to be present for a little while. He has asked me to conduct the hearing until he is able to get here.

Mr. Giraud, will you give your name, address, and occupation to the reporter.

Mr. GIRAUD. Gaston Giraud, commercial attaché for French Indo-China in the United States, located at San Francisco.

My purpose in appearing before the committee is to give my opinion on the adoption of the metric system in the United States. I am moved by my love for the United States, which I am serving in my official capacity in San Francisco, as well as for French Indo-China.

The simplicity of the metric system has already been dwelt upon, so I do not think it is necessary to refer again to that feature.

I may tell you that the metric system was adopted by France, my native country, many years ago, and since then the people of the country have decided that they will never go back to the old system, so simple and practical is the new one.

My broad international experience leads me to believe this is the best system to be adopted and the most simple system. It will eventually be adopted by all the countries in the world. My experience also led me to see, when I was in China in 1906, 1907, and 1908, the practicability of the metric system and the impracticability of the English system. Nearly all the railroad systems in China have adopted the metric system except one built by the British from Peking-Tientsin to Mookden. The Franco-Belgium Railroad, the Peking-Hankow line, was unable to get connection for freight and material with the British railroad because the standards of measurement were not the same.

As to trade between French Indo-China and the United States, in my official capacity in San Francisco I have seen many points of friction due to the difference of weights and measures between the two countries. For instance, one of the greatest far eastern industries which is a point of trade between the United States and French Indo-China is the bringing of rice to America to be transshipped either to Cuba, Jamaica, or a Santo Domingo port. There is nearly always litigation and friction on account of weights and measures. French Indo-China, being on the basis of the metric system, quotations and shipments are made in metric terms. In the United States they are buying in pounds, sometimes the short ton, sometimes the long ton—2,000 pounds or 2,240 pounds. So that if a man here is not fair, it will always be possible for him to refuse the cargo on account of the difference in weight. On the other side the weight is always the same. A metric ton is 1,000 kilograms. You can not get away from that.

It is so simple that Japan has adopted the metric system, China is going to adopt the metric system very soon—so I think if the United States should eventually adopt this system it would be a good thing for it—especially when you consider that your monetary system is based on the decimal system. You have gone away from the money system used in England, pounds, shillings and pence, and you have found that your monetary system used in the United States is very practicable. If you think that your monetary system based on the metric system is practicable, why don't you adopt the metric system for weights and measures?

It is not specially on account of the French people, who were the first nation to adopt the metric system, that I appear to give you my testimony, but because the system is the most practicable in the world. Some people on the side of the opposition will tell you that it will take some time and much trouble. I invite such people to study the simplicity of weights and measures in France since the metric system was adopted. When the metric system was adopted in France there was a little trouble, on account of the situation of the new Republic at the time, which was troublesome. This was, however, the only trouble that France experienced. Nevertheless the metric system was adopted in France almost immediately, and since then has proven practicable in every way.

Think of your experience in the late Great War. France and Belgium had the metric system; Italy had the metric system. England and the United States had not adopted the metric system. If you had had the metric system at the time you entered the war we should have been able to give you ammunition fitting your guns and rifles; and think how many lives would have been saved in that way. At the first period of the war when the British were fighting by our side, before you came into the war yourselves, we were unable to furnish the British with ammunition because it would not fit their guns and rifles. So they had to wait and get the ammunition from England. If we could have furnished them with some munitions at once, closer cooperation would have existed earlier and many lives could have been saved, because you see at certain times during the war British guns were silent because they had no more ammunition and we could not supply them with what they could use.

Furthermore, if all countries of the world had been standardized on the metric basis, the manufacturing of munitions for and in all countries would have been simple. I understand proof has been made that Gen. Pershing when he went to France was in fact compelled to adopt the metric system for making war maps and all kinds of calculations which were made in France on the basis of the metric system. And I have read a statement to the effect that Gen. Pershing advocated that all officers thoroughly familiarize themselves with the metric system before going to France, to have things more clear and to have a good understanding between the American staff and the French general staff.

I told you that Japan has adopted the metric system. Germany adopted the metric system many years ago. Nearly all the countries of the world have the metric system save England and the United States. I think it is up to you now in adopting this system to secure a very big advantage over England. You know the British are very conservative. They will keep their old system until they are absolutely unable to do so. Some American firms are already seeing the necessity of adopting the metric system.

For instance, take the rubber-tire manufacturers. The rubber-tire manufacturers are marking their tires in inches and centimeters because there are tires that have to be sold either in the United States or in foreign countries. If they were only in inches they could not be used in foreign countries, for it would be very difficult for the people to understand and make calculations.

Of course, not having this system, to adopt it will be a big change, but it will not be a very tremendous change, because in industry and trade the people will find it of very big benefit. They will deal with people who have for many years proven the simplicity of the metric system, and the United States will secure a great benefit from it.

I have read this bill and I think I approve the bill; but in my opinion, if you will allow me to say it, the period of 10 years is a bit too long. Of course, you will tell me that inside of the country you have to give a certain amount of time to make the change, but I think for foreign trade the period could be shortened a bit, you know.

On the Pacific coast in May, 1920, there was a great meeting with relation to the adoption of the metric system, and at that time many opinions were sent by prominent men abroad who were in favor of the metric system. I want to give you the declarations made by two prominent Frenchmen, Marshal Joffre and Marshal Petain, which I had the honor to read at the meeting in San Francisco. This is the declaration that Marshal Joffre wrote from Paris, April 23, 1920:

"I very highly approve of the initiative shown by the World Trade Club in trying to get the metric system adopted in the English-speaking countries."

This was especially for America, and Marshal Petain wrote from Paris, April 22, 1920: "I am confident that the adoption of the metric units will greatly facilitate the developments of greater economic relations between allied countries."

I have also talked the matter over with Marshal Foch day before yesterday. Of course, in the short time he had before leaving for Kansas City he was unable to give any declaration, but when he gets back here he will give me a declaration along the same line.

So I think with the coming conference for the limitation of armament and closer relations between foreign countries, it will be a very good opportunity to press the things that will help to create an atmosphere of better understanding, the purpose of this conference being, as I understand it, to create a better understanding between foreign countries and to create an atmosphere of peace, which is the basis for trade and all economic questions.

In adopting this system you will make a great advance toward better relations between the countries, and especially between France and America.

Senator LADD. It has been suggested that instead of making the adoption of the system compulsory at the end of 10 years, that a law be enacted that at the end of 5 years will require Government contracts and specifications be made in the metric system. Would that be better, in your opinion?

Mr. GIRAUD. I think it would be better.

Senator LADD. Do you think that would be better than to make it obligatory at the end of 10 years?

Mr. GIRAUD. Yes.

Senator LADD. Do you think that would result in its general adoption in all business lines?

Mr. GIRAUD. Of course for foreign exchanges it will be a good thing. If you think it will be too difficult to have the thing adopted in five years inside of the country, of course you may extend the period. Of course a change like that in certain parts of nations will find a little opposition, you know. I think it would be a good thing for the benefit of the bill, to make the thing run smoothly.

But for foreign relations I think it is imperative that the period be shortened as much as it can, because you will find a great benefit. Many questions, such as I have told you about, which arise sometimes between merchants in America and in other countries, will disappear immediately and it will be of great benefit.

Senator LADD. Is there anything further you desire to say?

Mr. GIRAUD. I think that is all.

Mr. CROCKER. I think, Senator, that Mr. Giraud misunderstood you in connection with your question as to a period of five years. That is, Mr. Giraud, Senator Ladd suggested that instead of the provision in the present bill, we might bring the metric system into the Government departments within five years. In that way, you see, the whole country would not use the metric system, only the Government departments, and through them it would eventually be used by the entire country.

Mr. GIRAUD. Oh.

Mr. CROCKER. You are not going on record here as being in favor of a bill that would just bring it into the Government, are you?

Mr. GIRAUD. Oh, no.

Mr. CROCKER. You mean, according to your testimony, that you are heartily in favor of bringing it into all the country at one time, but you also think that a clause providing for its use by the Government within three or five years might help in bringing it into general use for the entire country?

Mr. GIRAUD. Yes.

Senator LADD. Thank you very much, Mr. Giraud.

STATEMENT OF MR. F. W. ANDREW, CHIEF ENGINEER, EISEMANN MAGNETO CORPORATION, BROOKLYN, N. Y.

Senator LADD. State your name, occupation, and so forth, for the record.

Mr. ANDREW. F. W. Andrew, chief engineer Eisemann Magneto Corporation, Brooklyn, N. Y. I do not know, Senator, whether you want a little of my past history, to cover my qualifications.

Senator LADD. You might give a short statement as to your experience. We know that your company has been prominent in magneto production.

Mr. ANDREW. Those things are always a little bit delicate.

Senator LADD. But they are necessary.

Mr. ANDREW. I served as a young engineer at the General Electric Co. in the investigation of lighting matters; for a short period as engineer of the Russel Car & Snow Plow Co., making railway snow plows; as mechanical engineer in the designing of meters and instruments, for quite some years, with the Westinghouse Electric &

Manufacturing Co., also in the designing of arc lamps, potential regulators, and other electrical apparatus; assistant chief engineer of the Dayton Engineering Laboratories Co. in the designing of starting, lighting, and ignition for automotive apparatus; after that assistant chief engineer of the Remy Electric Co., making the same class of apparatus as at the Dayton Engineering Laboratories. For the last five years I have served as chief engineer of the Eisemann Magneto Corporation.

I want to confine my talk, Senator, largely to those matters relating to the metal trades principally, because that is all I claim to know about. Of course, I have a knowledge of the use of the metric system in regard to other matters, but I feel more or less qualified to talk on this subject of the metal trades.

My experience has been confined almost entirely to machinery, which is sold in large quantities, and the parts of which have to be strictly interchangeable. For instance a customer in Australia who sends for a repair part for his apparatus must receive a part which will fit properly without any fitting or filing.

For the first 17 years I did all my design and manufacturing by the present system of weights and measures now in use in this country, with the exception of those matters referring to electrical and chemical calculation, the standard reference works on which are now pretty generally written in the metric system—in fact, almost entirely.

When I took the position of chief engineer of the Eisemann Magneto Corporation, I was skeptical regarding the use of the metric system in this country. I felt that our present system was good enough; that to introduce the metric system into a shop would entail considerable expense and confusion. That is the natural thought one has.

The Eisemann Magneto Corporation, which is now American owned, was originally an offshoot from the Eisemann Magneto Co. of Stuttgart, Germany, and you may be interested to know that during the war we furnished about 85 per cent of the ignition for the United States war trucks. When they started manufacturing in this country first—that is, the foreign company—they had a German engineer and most of their mechanics were German born. The magnetos themselves were largely developed in Germany, and therefore it was only natural that the Eisemann Magneto Corporation should use the metric system from the start. They had no trouble whatever with it, notwithstanding the fact that they used drills, screws, and everything as far as possible by the metric system. In other words, they were able to buy those on the open market without trouble.

They soon found out, however, that they could not buy raw stock such as hexagon rod, round rod, sheet steel, sheet brass, the common articles of metal manufacture, to even metric dimensions. That is to say, they could buy them to American dimensions, which varied to some slight extent from what the metric dimensions would be if we had the metric system.

About that time I took charge of the work and simply called for the raw stock according to our present system of measurements right on the same drawing with the metric measurements. It can be done very easily. I think this would be a good time to show you an example of that right now. I am going to show you first rather a simple one, because simplicity is to be desired in these things. This [indicating] is a metric figure here; that is a metric figure there. But the stock from which we make that is standard quarter-inch rod in the commercial trade. A quarter inch is not an exact even dimension in the metric system. So when we are putting it in our otherwise metric drawing we simply say a quarter inch—mix it right in on the same drawing. There is no objection to it. See how it is done?

Senator LADD. Yes.

Mr. ANDREW. Here [indicating] is another case. We say five-thirty-seconds here [indicating], but we give its length in the metric system, because this is a stock article that we can buy in any warehouse as five thirty-seconds. We do not transpose from the metric system to the English at all. To do it in my opinion will entail endless complication, and that is the thing that is worrying a few individuals. They are afraid these things are going to happen, but they do not have to happen; you do not have to transpose at all. Simply where it seems desirable during this transition period of 10 years to put the present English system on the drawing, do it. At the end of 10 years, due to the fact that practically all design is changed in 10 years, anyway the way we are progressing now, we won't have anything but metric system figures.

If you would like to see a more complicated drawing, here is a drawing made up in the metric system [indicating]. I thought you might be interested in seeing it. It is like any other drawing, except we use these figures here [indicating]. For instance, that is 45.4 millimeters. You see no fractions on this at all. We do not use fractions in the metric system.

There is a case [indicating] where we saw fit to use an American thread because we had a screw that fitted that and we did not want to make another part. So we simply put in an American screw, or the English system, right on the same drawing with the metric. It is the easiest thing in the world. I was amazed when I found out how easy it was to handle this combined system.

I have some conversion tables here, and some other instances. Here [indicating] is a drawing that might be interesting. This shows one of our magnetos with both systems on it, so that there can be no question. This [indicating] is the one that goes out to everybody, and shows the size of the apparatus when they get ready to put it on their truck, or whatever it is to be put on. It is shown in both systems. The drawing is easily handled. We have no trouble with it whatever.

Here is an important thing, Senator, that I want to impress upon you. Should the metric system be made entirely mandatory I believe there is only one thing for the design departments of our manufacturers to do, and that is to design all new apparatus by the metric system, using the present system where the old part is used, such as I have shown you there, and as I have already shown, this mixing of the two systems is entirely practical.

Now, the important part. I am not in favor of asking our manufacturers to use the metric system alone after 10 years. I would like it limited to the extent that parts for existing apparatus may be secured—this is where my important point comes in. Suppose we sent a part to some place, a piece of sugar machinery, which is costing perhaps two or three thousand dollars. A piece of that wears out or is broken. We do not want to say to our American manufacturers "You can not sell that man a part for that old machine."

I would like the proposed law limited to the extent that parts for existing apparatus, when the metric law finally goes into effect, can still be made for supply purposes by the old system. The fact is that practically all our present designs are obsolete in 10 years, and this matter will quickly take care of itself.

It is interesting to know the effect of putting the metric system into a shop, especially a shop where interchangeable parts are manufactured in large quantities, and that is the class of business that is largely carried on in this country. One would think the shop would be thrown into great confusion. A study of the situation, however, will show that this is not the case, because practically every mechanic in the shop measures his work with some such gauge as a "go" and "no go" gauge; he does not use a scale at all; he does not know what the measurement is; he has no idea. He says, "It must fit in this and it must not fit in that." The fact is there are very few mechanics in the manufacture of interchangeable apparatus that have scales of any kind. So it does not make any difference what system they use. They might as well be using Chinese; they do not know the difference.

Senator LADD. One of the things which has been brought up is the question of inducing the merchant, the business man, to buy and sell products in the metric system, and the housewife who now goes in to buy in yards or the farmer who now buys and sells by the ton. Do you think that is a serious matter at all?

Mr. ANDREW. No. We have now, as you probably know, certain State laws which compel the manufacturers of practically all of that class of goods to put on his package the contents of the package. If it was said that in the package there were so many liters or so many grams, whatever the contents were, the housewife would come in and say, "I want a package of 10 grams of so and so," "2 liters of so and so," the same as she now asks for a gallon of kerosene or any other thing. It is printed on there, and it would come to her quickly. The metric system is readily visualized. I do not think you will have any trouble with that. That will have to come about gradually. But 10 years is a long time, and it can easily come in that period. Of course, there are a few people who are not blessed with as much wits as the rest of us that will never understand that, or anything else, for that matter.

But as we get into this we will be teaching it in the schools, more, perhaps, than has been done in the past. The only teaching I had in the metric system was back in 1891 or 1892, and I have not had to study it since, although I did not use it until 25 years afterwards, and I found no difficulty.

The few who have to use micrometers—a micrometer as you perhaps know, is a piece of apparatus for measuring down to a thousandth, or a very fine dimension. A hair in your head is approximately three-thousandths, and is considered a fairly close dimension. The few who have to use micrometers, such as the toolmakers, are usually of a higher grade of intelligence than the average worker, and we find we can bring such a man in from other employment to our works and he becomes familiar with the use of the metric system, to the extent that he knows how to use it for his purposes, within a few days.

The next feature is the cost of this whole thing which is sometimes thought to be prohibitive. The cost of tools for changing over from the present system to the metric

system may be divided into two classes: First, measuring tools, and second, fixed machine tools, or machinery.

Regarding measuring tools, by adopting the metric system it would be necessary to make this charge when changing over. There is no question about that, but the cost, as I have shown, is rather light, because the average man in the shop does not use or require measuring tools—that is to say, outside of the tool room. And the tool mechanic usually has a very good kit of tools, he takes pride in having them, and if he could buy something extra to make his tool kit look a little better he will usually do it, the same as a man owning a Ford car.

As to machine tools, they can be used to work to metric dimensions just as easy as they can to present dimensions, with but very few exceptions. Some people have not looked into that and they have a false notion to the effect that the lead screws on milling machines and lathes must be changed and the whole machine scrapped in favor of an entirely new machine. That is not the case. Our experience has been that we can get practically any thread on our lathes or use either lead on our milling machines, within commercial limits. That is to say, if you are working on scientific instruments, or something of that sort, it is not good enough. It is entirely commercial. The error is usually in what we call the fourth place—that is to say, the fourth decimal—which is so fine that there are very few instruments that can make it. The metric drills, metric taps, and gear cutters are not interchangeable with our present system, but these are constantly wearing out and it will be no hardship to change over on this account in ten years.

Senator LADD. You spoke of scientific instruments. They would constitute only a very small per cent, I would suppose.

Mr. ANDREW. Yes.

Senator LADD. Nearly all of those are already made in the metric system?

Mr. ANDREW. A great many of them are; that is true. The only change that would have to be made to make scientific instruments would be this: If you wanted to make a machine safe for the highest degree of accuracy, you would have to change the lead screw in the case of the lathe, or the lead screw in the case of the milling machine. This inaccuracy, however, does not always occur, as accurate work frequently can be made by either system on the same machine.

I believe that prosperity can not be revived to any marked extent until our export business has materially improved. There is no question in my mind but that the people to whom we export would like to use apparatus made by the metric system. I do not think that is open to doubt. It is easier to sell a man something he wants rather than something he don't want.

For instance, a man in South America buys a piece of our apparatus with our present screw threads in it—a little screw that perhaps cost us in this country 2 cents. He receives the apparatus down there. A screw has shook out during transportation, or it is not there anyway. He goes around to all their hardware stores and places where he purchases those things, and he finds that he can not get another such screw. If there had been metric screws in the apparatus he could have taken a screw from some other piece of machinery, or found it in a local hardware store. He could have gotten it easily. But as it is now he has to stop and make it according to our measurements, because he can not afford in such a case to send all the way up to the United States for one.

Senator LADD. That tends to discourage commerce——

Mr. ANDREW. That tends to discourage the export business. This whole business of the metric system makes me think of the growth of a small factory. You usually find that you have not got as large finances as you would like, and you put off getting this fixture and that fixture, etc., and throw your apparatus together more or less. After it grows a little bit, or you become prosperous, you begin to think, "Well, I have a shop here that needs some system in it. I have got to do something about it. I am going to throw out all this incompetency and put some sort of system in here, so that I can manufacture efficiently." That is exactly what we are trying to do in this country with the metric system.

At the present time you would be surprised to know that we are manufacturing now under the following gauges which are used for measuring different kinds of things. For instance, there is the American screw gauge that we use when we want to measure a screw. There is the Brown & Sharpe gauge that we use largely when we want to measure copper and the precious metals. However, everybody don't know that. Some of us in the business know it, but everybody don't know it. There is the Birmingham wire guage, which is also used for measuring copper, and the twist-drill gauge.

There is a guage in which I know you will be interested, because it will give you a kind of idea of what is going to come if you ask Government agents to buy by

the metric system—and that is the United States standard gauge. A number of years ago the United States Government decided they would buy all their material for the needs of the Government in the way of sheet iron and ferrous material by the United States standard gauge. What has happened? This is what has happened: Everybody that makes sheet iron and ferrous material to-day is using the United States gauge, because the Government insisted that is the only way they would buy.

Sooner or later that is going to come with the metric system. If in addition to passing this metric law in 10 years, you would say that in five years the United States Government will do all its buying by the metric system, it will help the cause that much more.

In addition to the gauges I have mentioned there is the Stubbs steel wire gauge, the National wire gauge, the Roebling wire gauge, the Washburn & Moen wire gauge, the Music wire gauge, zinc gauge, letter size drills, fractional drills, master mechanics gauge, the Trenton or Wolf's music wire gauge, and others. We are using all of those to-day, and everyone can be disposed of, Senator, by the use of the metric system. So with one measuring instrument we can measure a whole lot of those things without having to go to some sort of record, as I have here, to find out what a particular number represents, because we know all of those by number. Somebody will say "I want No. 20 Brown & Sharpe gauge" when they are ordering copper wire, and those that are not familiar with the gauge have got to go and find out what size is meant by Brown & Sharpe No. 20. Sometimes they say "I want No. 20," and you don't know whether it is Brown & Sharpe or Birmingham, because both are used. If we had the metric system, all that confusion would be done away with.

In addition to doing away with all these different gauges, I wonder if you understand what this metric system is going to do. It is going to throw out the Troy weight, which is used in measuring precious metals. It is going to throw out the apothecaries' weight, the use of which is evident; it is going to throw out liquid weights and measures; it is going to throw out the avoirdupois weight, which does not mean anything in export trade because the British is different from ours. Their foot is a little longer than ours; their gallon is about one-seventh more than ours. When we speak of avoirdupois weight in this country, as Mr. Giraud has suggested, what is a ton? The coal man buys 2,240 pounds and sells 2,000.

It is going to throw out all those systems, and we are going to have one system. We are going to systematize our weights and measures like this shop that systematizes its methods of manufacture, as stated previously.

Another thing: In our present system, when we are handling small apparatus, which I have been doing a good many years, the unit of 1 inch, which we now use, is not small enough, and we frequently speak of such dimensions as fifty-seven sixty-fourths. I ask you, can you visualize what fifty-seven sixty-fourths is? You can not. Hardly anybody else can. We don't know what those things are, and as a rule engineers who are working with these matters every day use decimals instead of fractions; but we would rather use metric decimals than present decimals. If you wanted to write that in metric dimensions you would write 23 millimeters. You can visualize 23 millimeters, but you can not visualize fifty-seven sixty-fourths, because it is a very unusual dimension.

So the present 1 inch is not a small enough dimension unit to use. Incidentally one one-hundredth millimeter is just about half as fine again—a little more than half as fine again—as one one-thousandth of an inch, so we have a finer measurement in common use in the metric system than we do in the English system. I have to use those every day and have had to use them for a good many years.

In addition to the chemical trade and the electrical trade using the metric system, it is rather common practice to manufacture ball-bearings in metric sizes; also magnetos made by mine and other companies than the Eismann Corporation.

Here is another thing: Metric dimensions are always expressed, as I think I told you before, in decimals. That comes home to me rather closely, because last week I was talking to my niece in Boston and she said, "Uncle Fred, I just can't understand these vulgar fractions and compound fractions." She is only a little thing. "Well," I said, "I don't know that I can blame you very much, but we will try and find out what is the matter here." If we had the metric system there would not have been any such thing, because we do not use fractions in the metric system. We use decimals and we multiply and divide by decimals. It will save our children all over this country for the next generation a very great deal of time in their study in school, if they can use the metric system, rather than to have to dope over those more or less complicated fractions, because they are hard to understand.

You might say, Senator, "All that you have said is all right, but what is this going to do to the average fellow in the shop; how is it going to benefit him? You say he does not use measuring instruments anyway. What is the good? What is the use of making all this fuss about the thing?"

The average follow in the shop is very much interested in this, but he don't know it, and I will tell you where he is interested in it. Our profits and our surplus money in this country come largely from export. If we can not export we can not overproduce. If we can not overproduce we can not give that man in the shop something to do. He is interested but he don't know it.

Senator LADD. The fear has been expressed that the farmer will not be able to understand his contracts, the buying of things and the selling of produce, by means of the metric system. Do you think that will be a serious handicap, as applied to those things; and also as to the housewife?

Mr. ANDREW. If you could see how the farmer—I was in the Middle West quite a number of years—took to automobiles, their operation and repair, and to tractors and their repair and maintenance, you would agree with me in this statement: I am not ready to believe that the American farmer is not up to the average standard of intelligence—and it takes very little—to be able to understand this system. The merest child can understand it in a very little while. As a matter of fact the farmer does not have to know the whole metric system. All he will need to know is the few units he is interested in, and that is all we care to have him know. But he is as intelligent as any other man in the United States, and a little more so—and I am not prepared to believe he will stand in the way of this matter.

Senator LADD. The housewife says she wants 5 yards of calico.

Mr. ANDREW. She will probably buy 5 meters instead.

Senator LADD. She wants a quart of vinegar.

Mr. ANDREW. She will buy perhaps 2 liters of vinegar.

Senator LADD. There will not be any great material difference between what she will get and what she thought she was getting?

Mr. ANDREW. She will know the second time she buys it. She will say, "Well, I did not get quite enough that time; it is a new thing to me and I did not get quite a much as I thought I was getting. Next time I am going to buy two liters and a half." It is similar to making bread or any other commodity. The recipe says put in a cup of water. She finds a cup is too much and she says "I am only going to put in three-quarters the next time."

Senator LADD. You do not apprehend there will be any serious difficulty then in putting it into commercial practice?

Mr. ANDREW. I do not. We are using it without any trouble at all. It is really surprising how easy the system is to put in, but you have of course to follow more or less rules in making the change. In changing over a large factory you have got to put somebody at the head of the factory that has a little bit of sense. The bill provides that the Department of Commerce shall help in the transition. I think also that the American Metric Association, which is more or less back of this matter, will be willing to disseminate any information they have on the subject.

It is like any other engineering problem, and, after all, it is an engineering problem. There is never anything done in the world that is not an engineering matter. We may not think that we are engineers, some of us, but we are usually.

I think I have kept you long enough, Senator.

Senator LADD. Thank you very much for the information you have given the committee. I believe there is another witness who is to appear later.

Mr. CROCKER. Mr. Vauclain is scheduled to appear at 4 o'clock.

Senator LADD. Senator McNary will probably be here at that time. He was so engaged at this time that he could not be present.

(An informal recess was taken, after which the hearing was resumed.)

STATEMENT OF MR. S. M. VAUCLAIN, PRESIDENT BALDWIN LOCOMOTIVE WORKS, PHILADELPHIA, PA.

The CHAIRMAN. Mr. Vauclain, will you give to the reporter your name and position?

Mr. VAUCLAIN. S. M. Vauclain, president Baldwin Locomotive Works, Philadelphia, Pa.

The CHAIRMAN. You know the purpose of the bill, I presume, to fix the metric system as the single standard of weights and measures in this country.

Mr. VAUCLAIN. Well, I have a copy of the bill.

The CHAIRMAN. Proceed in dyour own way an make such statement as you desire.

Mr. VAUCLAIN. What do you want me to do?

The CHAIRMAN. Have you read the bill?

Mr. VAUCLAIN. I don't know anything about the bill. So far as the bill is concerned I do not see that it accomplishes very much of anything except to apply this system to commercial transactions. As I would understand this bill, everybody could keep

right on making anything that they pleased, except that when they were billing the material out they would have to bill it out in metric equivalents.

For instance, if I were to order tubes for a locomotive I could order them 2 inches in diameter, but the manufacturer could not bill them to me 2 inches in diameter, without running the chances of making an illegal sale; that is, if I were not disposed to pay him for the tubes he could not collect on a bill for 2-inch tubes.

I do not see that this bill prevents anybody from making anything they please without any system of measurement whatsoever. I have had this carefully studied by another than myself, who seems to analyze the bill exactly as I do, in which he says:

"This act only applies to the commercial transactions of selling to domestic customers merchandise on transportation (see sec. 3) and specifically states in paragraph 2, section 8, that any system of weights or measures can be used in manufacturing establishments if desired. We could order boiler tubes in inches, but the tube maker would under the law be compelled to use the metric system in billing them to us. There is no penalty specified for noncompliance, but we would understand that failure to bill according to law would render such invoice illegal and should the debtor resist payment the creditor would be obliged to correct the billing before he could have recourse to law."

That is all I see in this bill. I do not see any provision in it for the adoption of the metric system for manufacturing purposes. I think we would be in exactly the same position we are to-day, with the exception of the difference in billing.

The CHAIRMAN. Would you make the use of the system compulsory upon the people?

Mr. VAUCLAIN. Of course, I can only look at this matter from the standpoint of my own business. It is a thing to which I have given a great deal of consideration. I believe that if the country were legally on the metric system, instead of the English system, that it would be very much more convenient, very much more desirable, than the old system, regardless of the accuracy of the meter.

It provides great simplicity of measurement of all kinds. In my own business I take no exception to working to the metric system as well as to the English system. We have to manufacture for some countries to the English system, and we manufacture for other countries to the metric system. We probably make less errors when working to the metric system than we do when working to the ordinary English measures which we now use, or are supposed to use as a standard.

The CHAIRMAN. Do you employ both methods in your manufacture?

Mr. VAUCLAIN. We use both methods. We not only build locomotives entirely to the metric system, but we build other locomotives entirely to the English system. We also have built locomotives half and half—part of the locomotive designed in the metric system and the other half designed in the English system—with no difficulty whatsoever.

The CHAIRMAN. Do you think there is an imperative need for legislation of this kind in view of your statement that you have no difficulty in using both systems?

Mr. VAUCLAIN. No. I think and always have thought that the proper procedure in regard to the metric system would be for the adoption of it by the Government in all of its departments. Let the Government decide, let the arms of the Government decide, whether it would be of any advantage to them to adopt the metric system, because they come in contact with all countries in the world using the metric system through the Navy and perhaps through the Army, but through the Navy much more than the Army. The engineering department would be able to determine whether it would be of any advantage to them or not. If it were once established as the standard of measurement by the Government, it would not be very long before it would be universal throughout the country.

There is not anything to be thrown away, that I can see, to make the change. If it were arbitrarily established it might make business good in certain quarters—manufacturing quart mugs and pint measures, measuring rules, and that sort of thing; but that is about all that would happen. It would be a trifling affair. It would not destroy the things that have been made, because any law of that kind would not conflict with the reproduction or repair of machinery, buildings, or anything of the sort, that have previously been designed and constructed to the English measure It would be the then standard of the country.

So in commercial business it would not prevent any manufacturer from replacing or furnishing repair parts for anything that had been previously constructed to the old standard measures; and, as for the new designs, it would not make any difference what measurements they would be in, because they would be new anyway, and the repairs to them would be in whatever system of measuring might be adopted.

I can not see, really, any reason why we should not have the metric system.

The CHAIRMAN. Do you see any reason why we should have it?

Mr. VAUCLAIN. Oh, I am not competent to judge whether everybody should have it. I think the Government is the most important arm to decide as to whether they wish to adopt it for all their work, all the various branches of their business. And if they do adopt it, there will be no difficulty in everybody else adopting it, and I think without expense—probably with profit.

You know we seldom know how good a thing is until we get to use it. We first object to it. Later on we embrace it and swear by it. That might be the case here. I remember when we were first asked to quote for locomotives in the metric system of measurement all my partners threw the drawings down. I said, "Why not? We will never learn sooner, and I propose we build these locomotives exactly in accordance with these drawings made to the metric system." And it did not cause us the slightest inconvenience. The bugaboo of tremendous mistakes, spoiled work, and everything of that sort faded. We did not have them.

During the war we did an enormous amount of work to the metric system. I remember when I was here on the War Industries Board, one of the remonstrances I made, not in writing, but verbally, was against the translation of drawings from the metric system to the English system before work could proceed. Why not proceed with the drawings in the metric system? The only answer was that they desired those for record hereafter in our own system of measures. But they would have been just as good records in the metric system.

To my mind it means no more difficulty working with the two systems of measures in your shop than there is with working to two different languages. If you speak German—very few people are speaking German now, but they are commencing again—you think it in German. If you speak French you think in French, and if you speak English you think in English. One language is just as easy as the other. If we are going to work in the metric system we will think in the metric system, and you have no difficulty. You know how long a meter is, and you can visualize a meter; you can visualize a millimeter. Very few people pay any attention to the centimeter, as the millimeter is so easy to handle. A thousand millimeters is a meter. It is just as easy as when you take the conversion of standards which we have now. For instance, take railroad iron, take a 100-pound rail; we know a 100-pound rail is 100 pounds to the yard. What is the matter with a 50-kilo rail, because 50 kilos would be 50 kilos to the meter. You will find if you figure it out that in about 110 pounds there is only one-fourth of a pound difference in the weight of the rail, in a yard of rail. So it is negligible. After all, those things are easily determined.

Take the matter of gauges in the workshop. It is strange to the layman, but not to the engineer, that it is not the measurement that determines the size of anything. It is how large that thing ought to be to stand the load or stand the strain, whether it is figured by the metric system, by the English system, or by any old system. If it is an axle, it is an axle of a certain diameter. You can call it in inches—you can call it 6 inches. If you want it in millimeters you would strike probably 150 millimeters—whatever the exact conversion would be. It would be a certain size. You can not vary very much in order to get fine dimensions; the determination is so fine when properly made as to the correct sizes. For machinery their proportion is so delicately worked out that whatever it is, that it is. It does not make any difference with what you measure. You can measure it by the Irish mile if you want to, but it would be whatever size was necessary.

The figures on these dimensions are only given in order to be of record, or to enable the operative to visualize approximately the size, and then by delicate calipers, which are always gauged in the tool department, the article is finished to that. You can take lots of caliper gauges, and there are various sizes of them, and by simply stretching them on one side or the other you adjust them either to an inch dimension or a metric dimension, using the same gauge all the time. These gauges all have to be tested anyway before they are put out for a measurement, no matter how often they are used. Take, for instance, a 6-inch gauge for measuring a 6-inch axle; every time it goes out of the tool room it has to be examined to see if it is correct, because they change.

I think the Bureau of Weights and Measures here have given this matter a great deal of consideration and research and I think the committee should attach a great deal of weight to what they might have to say.

The CHAIRMAN. We have had them here. They are for it.

Mr. VAUCLAIN. Personally I am opposed at this time to adding any additional inconvenience to any manufacturer who is struggling to get on his feet. I do think, however, that the metric system would be a great improvement for everybody over the English system of measurement. Thirdly, I think to make a start in that direction it should be adopted by the Government, and the outside manufacturers or busi-

ness men should not be called upon to adopt it unless they so desire, until the matter is in good working order in Government circles.

The CHAIRMAN. Then your position is this, that you do not find any grave difficulties in the use of the two systems; you do not believe in imposing it upon people who do not want it; and you think if any action is taken at all it should be by the Government leading the way?

Mr. VAUCLAIN. The Government ought to lead the way. It would be a fine state of affairs, you know, if the manufacturers were compelled to use the metric system, and the Government would not do it. We would not get anywhere.

The CHAIRMAN. Is there anything to prevent those manufacturers who desire to do so, from adopting it and using it as their system?

Mr. VAUCLAIN. Nothing at all, excepting a manufacturer uses the measure that his customer wants him to use. For instance, I would not want to force locomotives on the French Government built to the English system of measurement, because the metric system of measurement is their standard. I would cheerfully and gladly build them all to the metric system. The same way as to the Brazilian Government; if they want theirs to the metric system, certainly. In Norway, if they want half to the metric system and the other half to the English system, why not let them have it that way? There is no inconvenience to do it. Everything fits.

The CHAIRMAN. Do you believe in a rule, or a law, that would compel in an arbitrary time, say a period of transition of five or ten years, this system to be forced upon the people of the country?

Mr. VAUCLAIN. I could not say. I probably will be dead at that time.

The CHAIRMAN. We hope not.

Mr. VAUCLAIN. Ten years from now.

The CHAIRMAN. It is not likely. The point is whether it would be good legislation to do that.

Mr. VAUCLAIN. I think we have had enforced on the country a good deal of legislation. Take, for instance, the use of the electric headlight, making that compulsory on the railroads. I could enumerate a very great many compulsory laws that have been enacted and everybody has had to conform to them. Take the matter of automatic couplers and the matter of automatic air brakes.

The CHAIRMAN. That was in the interest of public safety. That is a very different matter.

Mr. VAUCLAIN. We could adopt the metric system of measurement by a certain time. I think it could be done without any serious difficulty.

The CHAIRMAN. Is it worth the cost that would be assessed against the public in making the changes, and the inconveniences that would result from the enforced change?

Mr. VAUCLAIN. I do not see where you are going to save anything particularly, except to make things a little more convenient and consistent with a greater number of countries than now. I do not think it is going to cost so much to do it, if it is done properly.

The CHAIRMAN. Do you think that our foreign business is being hampered in any way, or the dealings between States, by reason of not adopting this system?

Mr. VAUCLAIN. Not the slightest. The only interference with foreign business now are the rate of exchange and the high rates of wage paid labor in this country.

The CHAIRMAN. I quite agree with you—those and other things. But two or three people have testified here that one of the troubles why the farmer can not get rid of his potatoes, for instance, is because we have not adopted the metric system.

Mr. VAUCLAIN. I do not see what that has to do with it. I think the farmer would measure his manure, not by the metric system or any other system, but by the wagon load.

The CHAIRMAN. In your business would you sell another locomotive, or any of the products you manufacture, more than you do now, if we had the metric system?

Mr. VAUCLAIN. No; it does not interfere at all. I think I have about the most satisfactory foreign business of anybody, which I have built up. I am running now 60 per cent foreign.

The CHAIRMAN. In order that the record may show the magnitude of your business would you approximate your annual gross business, or would you prefer not to do that?

Mr. VAUCLAIN. Our foreign business is always more profitable than our domestic business. Taking the invoice value of the goods, out foreign business is more profitable than the domestic. I can not give you the exact figures because they would vary.

The CHAIRMAN. Approximately, could you give some idea of the volume of your business, for the benefit of the record?

Mr. VAUCLAIN. We are running to-day probably 60 per cent foreign business. We are not running very heavy, in the neighborhood of $2,000,000 a month. But we have handled four or five million dollars a month. However, everything is dull now. It is just as dull in foreign countries as it is in this country. It is only by exceptional inducements that foreigners will order.

Then our prices are higher than German prices. We are up against German competition. The English and the French don't bother us, excepting when we compete in France or England. When we compete in China we pay no attention to any of them.

I just secured some orders in South America, large orders, in competition with the Germans. But it is not the system of measures that is going to bring you foreign business. It is your ability to handle foreign business, and understanding how to negotiate. It is the commercial side of the question. It is immaterial what system of measures is used in construction. That does not make any difference in the price of an article. You can build in one as well as in another.

I do not know that I have anything more to say.

Mr. CROCKER. If you could not make the locomotive on the metric system——

Mr. VAUCLAIN. There is not any "if."

Mr. CROCKER. If they want the locomotive built to the metric system, you have to sell it on the metric system. But in a plant where the machinery would be much more delicate, where they sell the bulk of their product in this country, and also have to sell to foreign countries in the metric system, is not the situation different? The point has been brought out here repeatedly that the people in South America want their imports made on the metric basis, and if the concerns here in this country are spending their money in order to make a product by the use of the English system, they would also have to have another——

Mr. VAUCLAIN. While they were making this work to the metric system, they would not be spending money working to the English system. They would not have to spend any more money to make it to the metric system than to the English.

Mr. CROCKER. Don't you think it would be simpler if you had just the one system?

Mr. VAUCLAIN. I don't think so.

Mr. CROCKER. And that there would be some saving?

Mr. VAUCLAIN. There is nothing in the measure which would simplify manufacture. If you would make everybody buy the same sized hat or the same sized locomotive, then you would have to have only one series of blocks and patterns. There would be no variation in the type. It is variation in the type and design that causes a man to spend money in his factory to prepare to manufacture a certain thing.

For instance, you never build the same locomotive over the second time. Nobody ever wants a locomotive the second time after it is first built. They use it for six months or a year. Then there is some improvement to put on it, some change in design. They come back and want 50 locomotives, duplicates of the last engine all but—and the "but" comes in. Then you have to make a new design to incorporate the changes. A man may have a 5-inch frame on his locomotive and he gets an order to make up that locomotive with a 6-inch frame. That knocks out everything. You have to design a new locomotive. Nevertheless, it is supposed to be a duplicate of a former order, "all but."

It would not make any difference whether it was in the metric system or the English system, or you might go away back to the days of Solomon and use his system of measuring. Just so you understood it, it would be just the same.

Mr. CROCKER. I have in mind an oil company. They had to dig some oil wells, I think it was in Roumania. They piped their lines and they found they needed more pipe. They had bought their pipe originally in America. They wanted to buy some more pipe, and what they could get there in that metric country would not fit what they had been using, which had been brought from America.

Mr. VAUCLAIN. That is no difficulty. If I had had charge of that job, all that I would have done would have been to make a change sleeve from one pipe to the other and gone on with the pipe that I was able to get there. There would be no difficulty about that, no more than there is in building a locomotive one-half in the metric system and the other half in the English system.

Mr. CROCKER. This company could not apparently use the metric dimensioned pipe they found over there because it would not fit the English dimensions. Roumania wanted to sell the pipe made in the metric system.

Mr. VAUCLAIN. That was propably just an excuse not to buy the pipe. If the American pipe people had been at all smart they would certainly have furnished American stuff.

Mr. CROCKER. But the point is that the Roumanian people don't want to deal with other than metric weights and measures.

Mr. VAUCLAIN. Take the matter of bolt threads on a locomotive. There are almost as many standards of threads as there are bolts. There is the Whitworth thread that is the standard in the English system. We went to work in the United States and "buggered" that all up and we changed it just enough to make a difference. You can't use a standard United States nut on a Whitworth thread, and the procedure was ridiculous. The Franklin Institute got it pushed through, and the Government adopted the United States standard thread, which however differed from the English. If they had adopted the Whitworth thread in the beginning, when every man here had his own thread—and there were about 100 different kinds of thread in the United States until the Franklin Institute turned out this new thread—if they had adopted the Whitworth thread, then there would have been only one thread in the United States and one thread in the British possessions.

Now we build locomotives to English drawings and use Whitworth threads instead of United States threads. It is immaterial to us what they ask to be put in. There is no inconvenience at all. The French have various kinds of threads in different sections of the country. We build for the French in the metric system and use standard of threads that are not in the metric system. In Russia we build locomotives to the metric system and use bolts that are made to the English system. There is no difficulty. That is, I think, because they bought their first gauges from the British and their first locomotives from the French. They got their French design in the metric and they persist in the use of the metric, and also persist in the use of the English bolt dimensions.

On the military side of manufacture, the military drawings for guns and ammunitions and all that sort of thing, are made to the English measures. There are no metric measurements for military supplies in Russia. It is just as easy to make them in one as in the other.

The CHAIRMAN. Mr. Vauclain, we are very much obliged to you for the information you have given the committee. It has been exceedingly practical and I know that good use will be made of it.

Is there any further witness, Mr. Crocker?

Mr. CROCKER. Not at all.

Senator LADD. Mr. Chairman, I desire to submit for the record the following letters.

The CHAIRMAN. They will be printed in the hearings.

(The letters referred to are printed in full, as follows:)

LA SALLE, ILL., *October 11, 1921.*

Hon. E. F. LADD,
United States Senate, Washington, D. C.

MY DEAR SENATOR: Your courteous letter of October 1, inviting me to appear before the Senate committee to testify as to the advisability of the gradual introduction of the metric system of weights and measures, as provided for in Senate bill 2267, reached me while sick in bed, which accounts for the delay in my reply.

I am slowly recovering from a severe illness, which kept me in bed three months, and I have just returned to my business here after an absence (partly abroad) of over a year. As a result, there are many very important business matters which require the attention of myself and colleagues, and I can not leave at this moment. Besides that, I am forbidden by my doctor to do anything which requires intense mental effort or is of an exciting nature, until entirely recovered.

For these reasons (familiar to Senator Weller of your committee) I am afraid to tender a formal acceptance of your invitation, much as I wish to add my effort to the passing of the excellent bill under discussion.

I should like to put myself strongly on record, however, as favoring S. 2267 as a wise, conservative, and constructive neasure, and as an example of the best type of statesmanship.

I believe the introduction and use of the metric system is absolutely necessary if we are going to retain any of our fast disappearing foreign trade, and that there is no question now before Congress of more importance than the passage of this bill.

Early in 1914 I made a special voyage down the east coast, and up the west, of South America, to study this (among other) subjects, and I was convinced that the principal reason why the Germans were getting the South American trade in competition with better English and American goods was because they used the same weights and measures (the universal or metric system) that the buyers used, while we (and the English) used the bewildering, foolish, and complicated English system.

Bill S. 2267 removes each and every objection urged against the metric system by the opponents. It very clearly and explicitly states that it does not necessitate any change in threads of nuts, gauges, or other machinery or appliances for manufacturing; and hence does not entail the expense of millions in the installation of new machinery;

[illegible]

[illegible]

[illegible]

[illegible]

[illegible]

[illegible]

[illegible]

Very respectfully,

Geo. P. Blow.

Babson's Statistical Organization,
Wellesley Hills, Mass., October [illegible], 1921.

Mr. E. F. Ladd,
United States Senate, Washington, D. C.

My Dear Mr. Ladd: Replying to your favor of the 1st it will be impossible for me to go to Washington now. I am, however, much in favor of the adoption of the metric system and I hope that the bill S. 2267 will go through. Regretting that I can not be with you in person, I am,

Yours truly,

Roger W. Babson, *President.*

Commercial Union of America,
New York, October 6, 1921.

Hon. E. F. Ladd,
United States Senate, Washington, D. C.

Dear Sir: Your letter of October 4 in reference to bill S. 2269 to secure the use of the metric system of weights and measures through the United States has been received.

We are interested in what you are doing and appreciate keenly the necessity for a unifying of the systems of measuring. A large portion of our business is with foreign countries where we are obliged to make quotations in the metric system.

It is regretted that it will be impossible for the writer to attend the hearings on the above mentioned subject on October 11. We wish to express, however, our thanks for the courtesy you have extended by inviting us to be present and we wish you every success in your undertaking, which, we feel, is a very worthy one.

Yours very truly,

E. D. Horner, *General Manager.*

NEW YORK, *October 9, 1921.*

Hon. E. F. LADD,
United States Senate, Washington, D. C.

DEAR SENATOR LADD: Owing to my recent absence from town, I have just received your letter of the 4th instant, inclosing a copy of S. 2267, to fix the metric system of weights and measures as the single standard for certain uses.

I am very sorry to be unable to accept your invitation to attend the hearings of the Committee on Manufacturers which start at 11 a. m. on October 11. I have a fixed engagement in New York on that date, and on the following day am obliged to leave for Canada, where I have engagements long since contracted for the rest of the week.

As regards the adoption of the metric system, perhaps I ought to state that my attitude in favor of that measure has been influenced by what seems to me to be the reason of the thing rather than by a minute and detailed study of the subject. Two or three years ago I received a great deal of printed matter issued by persons opposed to the adoption of the metric system. I did not find it convincing, as the underlying thought seemed to be simply that of the care and preservation of what may be called vested interests in our present system; but I noted that many assertions were made which it seemed to me could be met only by an expert, who had all the facts at his fingers' ends. I happened to know, from such information as I possessed, that some of the assertions were incorrect and misleading; but there were other assertions which, although I believed them to be of the same kind, I should not have felt at liberty to deny offhand. For this reason I declined an invitation to a public debate with one of those who were chiefly concerned in putting out the printed matter above mentioned, giving as my reason that, if his object was to discuss the matter on the merits, and thus contribute to the enlightenment of the public, he should invite some one to debate with him who was a specialist in the subject and who was acquainted with all its details and had the facts and figures at his command.

I recall the fact that, in one of the pamphlets sent to me, the statement was made that the countries of Latin America did not in fact use the metric system as generally as we were accustomed to think, and that they used our system as well as their own. Naturally, in their dealing with the United States, they have to convert the figures of the one system into the figures of the other; and the effort to create the impression that, in consequence of this fact, the metric system was not their legal and actual standard caused me to feel a general lack of confidence in assertions regarding particular facts with which I was not familiar.

Very truly, yours,

J. B. MOORE.

POUGHKEEPSIE, N. Y., *October 8, 1921.*

Hon. E. F. LADD,
United States Senate, Washington, D. C.

DEAR SIR: I have your kind invitation to appear and bear testimony in favor of the introduction of the metric system, but regret to say that it will be impossible for me to be in Washington next week.

However, my brother, Theodore H. Miller, intends to come, and he has the advantage of being superintendent of a large machinery building establishment in which the change was made some years ago from the English to the metric system.

As I understand it the proposed bill permits any manufacturer to use within his own works any system he may prefer, and that it is only in his dealings with other people or with the public that he must use the metric system.

I believe this feature of the bill eliminates the last feature to which valid objection can be made by anyone.

Very sincerely, yours,

FRED J. MILLER.

NEW YORK, *October 10, 1921.*

Hon. E. F. LADD,
United States Senate, Washington, D. C.

MY DEAR SENATOR: I have your kind letter of the 1st instant and would be glad to appear before your committee in behalf of the adoption of the metric system, October 11, if it were not for the pressure of professional matters here in New York, which make it difficult for me to get away.

I have always felt that the adoption of the metric system would very greatly enlarge our trade in Latin America and in all countries where the metric system is in effect. I would suggest that you get Dr. Leo S. Rowe, director general of the Pan American

Union and formerly an Assistant Secretary of the Treasury, to appear before the committee. He is well up on the metric system and can argue effectively for it.

With all good wishes, I am, sincerely, yours,

W. G. McADOO.

CHICAGO, *November 2, 1921.*

Hon. EDWIN F. LADD,
Senate Office Building, Washington, D. C.

DEAR SIR: Senate bill 2267 has been called to my attention and I write to express my sincere hope that a law making the use of the metric system compulsory after a very limited number of years may be passed by Congress.

I am quite well aware that many manufacturers are opposed to the introduction of the metric system. That is to be expected. The human race is very reluctant to change to better methods, especially where it involves even a little bit of learning something new. It seems to require a trip hammer to effect any general movement in the line of progress.

I am quite conscious of what would be necessary to adapt our machinery and drawings and train workmen for the use of the metric system, but am willing to make that change, which would not be serious either from the standpoint of expense or loss of efficiency during the transition from the old system to the new. To this company, of course, the greatest loss would result from restriction of the sale of calculators which the introduction of the metric system would bring about. However, I am willing to stand even that in the interests of the general welfare.

Our experience in selling calculating machines in Great Britain and the United States, as well as in many countries where the metric system is standard, convinces me that in domestic, as well as in international, business the denominal system places any country at a great disadvantage, as compared to countries having a purely decimal system.

A calculating machine handles denominal numbers almost as easily as decimal numbers. Therefore, we have found it very much easier to introduce and to sell comptometers in countries which do not have the metric system. This was emphasized during the war by action of the British Government in facilitating shipment of comptometers on a par with war munitions, while France, with a metric system, to help exchange could afford to put an embargo on the import of all mechanical calculators.

Only after years of practice can a man become efficient in mentally multiplying and dividing British currency, therefore the British Government figured that a comptometer and an operator out of one of our schools could take the place of five expert computers who went to war.

Very truly, yours,

D. E. FELT.

NEW YORK, *November 2, 1921.*

Hon. E. F. LADD,
United States Senate, Washington, D. C.

DEAR SENATOR: Referring to your kind letter of October 28, in re metric system bill and the hearings before the subcommittee, I beg to thank you for the copies of the bill and the record of the earlier hearings.

I wish to congratulate and thank you for your introduction of this bill and efforts in its behalf. As a student of metrology, I can assure you that all reforms in weights and measures have had to be forced upon the general public, which consistently has failed to appreciate not only their importance and advantage, but also their pressing necessity.

All of the great forward movements in this direction have been due to the efforts of a few men of great vision and altruistic ideas, whose efforts have aroused little interest and enthusiasm on the part of the people they were destined to benefit. To mention a few instances one has only to refer to the valuable work of Thomas Jefferson and John Quincy Adams in this country.

The public always suffers where weights and measures are complex, uncertain, or badly maintained, and it is the people at large, especially the poor and less intelligent rather than parties of special interest, who are the victims, as they can not or do not readily protect themselves. Consequently any effort to improve weights and measures will result in benefiting mankind and advancing civilization.

Now, if all our weights and measures were reduced to the decimal system we would have the same interrelation as in our very simple currency and coinage. Liberty bonds owned by the people are bought, sold, and quoted in decimals, not in the eighths of the less widely distributed securities. Anyone who can understand the

United States money can understand the metric system and in the various units there are convenient points of contact with the Anglo-Saxon system, much closer in many instances than the practice of measuring as customarily practiced secures.

My experience has been that a change to new weights and measures is readily accomplished when the people are forced to it, as for example in the scale of foodstuffs by weight instead of capacity measures now required by statute in many States for the ordinary markets as well as the larger transactions of commerce. Likewise the general use of the international metric carat which this country adopted in 1913 and which is now universal for all nations.

The increased accuracy of the milk bottle in a number of States has been secured by legislation and better administration promoted by a few men and women of altruistic and disinterested feelings rather than by any widespread popular demand, but unquestionably it has benefited the people and especially the poor in the great cities, who are spared short measure.

The old fifth of a gallon bottle too often masqueraded as a full quart, even after the contents in ounces were put on the label, but there was no general movement to lead to its abolition.

Those to be benefited most by the adoption of the metric system are the so-called plain people, who to-day are ignorant of its advantages and for whom there should be legislation that will simplify the problems of their daily life and improve their condition and small business relations.

For industry in general it would seem to be only a matter of time when the metric system comes into use in the United States as a part of more efficient management and accounting. Furthermore, there is a growing realization that irrespective of the merits or demerits of the metric system the American "system" of weights and measures based on the British has little to commend it. In fact, outside of units and measures of length, where there is fair ground for debate, I have yet to find an intelligent person who does not agree that our measures of weight and capacity stand in need of substantial reforms and simplification.

As was stated in 1902 in the antimetric argument of the discussion of the American Society of Mechanical Engineers, "there is no reason for the English system retaining the gallon and the bushel, except that they are in such common use," and also the suggestion is made "both Troy weight and apothecaries' weight might be abandoned." Consequently, if our weights and measures need improvement and simplification let us have the best.

In regard to the bill itself I regret that it does not provide for the earlier and compulsory use of metric weights and measures by the Government, especially in specifications for supplies and materials and in the standards for various articles and material now being so efficiently developed at the Bureau of Standards. If the coal bought by the Government was weighed in metric tons and the paper at the Government Printing Office bought to metric weights and dimensions a great step forward would be taken. Then, if postal cards, envelopes, Treasury warrants, and other forms were developed and standardized on a metric basis the sizes soon would become national and uniform. Such a general standardization based solely on efficiency and economy of material might soon spread through the entire Government.

Let me assure you this work is for the people, and so far as I have observed most of the opposition has come from certain special interests and a few wealthy manufacturers personally rather than the public at large.

I note that you addressed me at Columbia University. My active connection with that institution ceased some years ago and I am now engaged in special research work in addition to being technical editor of the New International Encyclopædia.

Trusting that you will meet with success in your efforts,

Very truly, yours,

HERBERT T. WADE.

The CHAIRMAN. That will conclude the hearings at this time for the proponents of the bill. When the opponents of the bill have notified the chairman of the subcommittee they are ready to proceed, a date will be set for the resumption of the hearings. The subcommittee will adjourn to meet again at the call of the chairman.

(Whereupon, at 4.30 o'clock p. m., the subcommittee adjourned subject to the call of the chairman.)

THE METRIC SYSTEM.

WEDNESDAY, DECEMBER 14, 1921.

UNITED STATES SENATE,
SUBCOMMITTEE OF THE COMMITTEE ON MANUFACTURES,
Washington, D. C.

The subcommittee met, pursuant to call, at 11 o'clock a. m., December 14, 1921, in the committee room, Capitol.

Present: Senator Charles L. McNary, chairman.

The CHAIRMAN. We will resume the hearing on Senate bill No. 2267, to fix the metric system of weights and measures as the single standard of weights and measures for certain uses.

STATEMENT OF MR. C. C. STUTZ, SECRETARY AMERICAN INSTITUTE OF WEIGHTS AND MEASURES.

The CHAIRMAN. State your full name, address, and occupation.

Mr. STUTZ. C. C. Stutz, 115 Broadway, New York City; secretary American Institute of Weights and Measures.

The CHAIRMAN. You appear in opposition to the proposed legislation?

Mr. STUTZ. Yes, sir.

The CHAIRMAN. Proceed in your own way.

Mr. STUTZ. I have prepared, as secretary of the American Institute of Weights and Measures, a brief which we would like to have made a part of the record.

The CHAIRMAN. You have condensed there practically all that you have to say with regard to your opposition to this bill?

Mr. STUTZ. Yes, sir.

The CHAIRMAN. And you desire it incorporated in the record as part of your statement?

Mr. STUTZ. Yes; I would like to have that go in the record.

(The brief referred to is here printed in full, as follows:)

DATA AND ARGUMENTS IN OPPOSITION TO BILL S. 2267, RESPECTFULLY PRESENTED BY AMERICAN INSTITUTE OF WEIGHTS AND MEASURES, C. C. STUTZ, SECRETARY.

STANDING OF THE AMERICAN INSTITUTE OF WEIGHTS AND MEASURES.

The American Institute of Weights and Measures, represented at these hearings by its secretary, was organized for the purposes of defending the existing American system of weights and measures against prometric propaganda, and to study and advocate such coordination and simplification of the existing system of weights and measures that might appear to be desirable.

The organizers of the institute comprised a group of important industrialists who appreciated the gravity of unwise attempts to disturb the existing system of weights and measures. Immediately following the organiaztion of the institute accessions to membership became rapid and at the present time the list of members comprises 566 supporting corporations, partnerships, and individuals, mainly manufacturers, employing an aggregate of over 500,000 persons.

PART 1.—OBJECTIONS TO SENATE BILL S. 2267.

Section 1: This section would make the use of the metric system compulsory for certain uses after a period of 10 years. This 10-year period, however, can arbitrarily be set aside by other provisions of this bill which deal with the enforcement of this law as will be shown when considering section 5.

Our objections to this section are:

(1) We are opposed to legislation aimed at making the metric system the single standard of weights and measures in the United States and involving thereby also the prohibition by law of the use of our present English system now employed by our people and in daily use with us since the days of the earliest settlements.

It is on this English system, uniform throughout this country, that our industrial achievements have been built. It has adapted itself to changing conditions, serves our purpose well, and in our judgment no sound or convincing reason for scrapping it has been produced.

(2) We are opposed to installing the metric system by compulsion. Any existing system of weights and measures affects the daily habits of every inhabitant of the country, men, women, and children alike. Experience has shown that it is impractical to change such deep rooted habits by law. Such results can only be achieved gradually by education and evolution, and not even then unless the change can prove its merits. Even among those in favor of the metric system the greater part are opposed to compulsory legislation.

(3) We do not believe the metric system to be superior to our present and established English system for reasons to be stated later.

(4) The law of 1866 makes the use of the metric system permissible, those who want to use it can do so. In spite of this permission it has made little if any progress in the industrial and daily life of this country.

Section 2: This section has to do with a fundamental principle and requires a somewhat extended treatment. It is therefore reserved for a special chapter under the title "Our present standard."

Section 3: (1) Those engaged in domestic trade are opposed to the use of the metric system. This trade comes into intimate contact with that mass of the population which will be most difficult to educate in the new system. The reasons for objecting to such legislation are set forth in Part 2.

(2) Railroad companies and transportation agencies are opposed to this provision, as explained in Part 2, paragraph 6. They consider them as being revolutionary in character, excessive in cost, a source of constant irritation and misunderstanding in their dealings with customers, both firms and individuals, as well as in the administration of their own affairs.

Section 5: Under the law of 1866 Government departments have the privilege of installing the metric system. The phrase, "not later than 10 years" exempts those departments having charge of the duties enumerated from the 10-year waiting period and specifically compels them to install the metric system on or before that period.

Of the various governmental departments, the post office comes into most intimate contact with the people. An executive order, issued by the Postmaster General, would at once confront the general public, as well as all employees of his department, with a strange language producing only confusion and resentment. The rewriting of tariffs, contracts, and regulations, as well as the changing of all weighing devices are incidents, the cost of which must be borne by the whole population.

The Treasury Department as the revenue-collecting agency of the Federal Government would be confronted with the necessity of recalculating all tariffs based on weights and measures, except those "ad valorem." Its statistics would be unintelligible to the public if given in the strange new language.

The tax and revenue collecting departments of the different States not being affected by the conduct of the Federal Treasury would probably await the expiration of the 10-year period, thus creating a condition absolutely intolerable, especially if the Treasury Department should take advantage at an early date of this provision in section 5 of the bill.

Section 6: This section seeks to delegate to the Department of Commerce the whole machinery for the enforcement of this act. Thus there would be created an autocratic control by a Government bureau by which it would have power to impose such rules and regulations for the enforcement of the act as it might see fit.

Section 7: Repeals all acts or parts of acts "inconsistent herewith." In an act, which is open to various interpretations, it would be difficult to determine what was or was not "inconsistent herewith," especially if we include the "rules and regulations for its enforcement."

Section 8: Clause 2 specifically allows the use of the English system in manufacture, subject, however, to the general provisions of the bill.

The scheme of trying to maintain domestic manufacture on the English system and domestic trade on the metric system, as provided in section 3, presents many obvious difficulties. Certainly it would impose a dual system, which has been the curse of compulsory metric adoption wherever it has been tried.

While the manufacturer could produce his goods, pack, fold, and supply them in accustomed containers he could only sell and bill them in metric terms. Finished or semifinished material needed in producing them could likewise only be bought in metric terms, thus entailing on his purchasing, accounting, and sale departments a burden costly and extremely vexatious.

Section 9: This section imposes on the legislative bodies of States and cities the necessity of redefining the various laws and ordinances having to do with weights and measures in metric terms.

Section 10: This section defines individual and corporate responsibility for living up to the provisions of the bill. No penalties are provded for nonobservance. Previous metric bills mentioned penalties. It is not probable that Congress would pass a law and be indifferent to its enforcement, nor could it delegate to the Department of Commerce, entrusted with its execution, the task of fixing such penalties. Unless this section is enlarged to include penal provisions, additional laws would have to be enacted by Congress on this subject.

GENERAL OBJECTIONS TO THE BILL.

We object to the bill as a whole on the ground that it is an attempt at a partial compulsory introduction of the metric system with the view of destroying the existing uniformity in the matter of weights and measures as used at present by the English-speaking peoples, in the hope and expectation to then replace the confusion so created by a sweeping compulsory adoption of the metric system, a system which in practice has not proven the advantages claimed for it.

The bill as a whole is loosely drawn, the relation of its various sections is obscure and indefinite, and its real meaning is concealed.

AMERICAN INSTITUTE OF WEIGHTS AND MEASURES,
115 Broadway, New York, N. Y.

OUR PRESENT STANDARD.

Section 2 of the bill mentions certain metric standards deposited with the Bureau of Standards. Lines 5 to 8, inclusive, of this section (on p. 2) read as follows:

"These national representations are hereby adopted as the primary standards of weights and measures for the United States of America, and from these all other weights and measures shall be derived and ascertained."

This wording clearly indicates that the framers of this bill are fully aware of the fact that the standards mentioned in this section are not at this time legal standards of the United States of America. For if they were now legal standards this section 2 of the bill would not specifically ask the Senate to legalize them.

Neither are they legal standards for the United States, but they do bear a certain legally defined relation to our fundamental standards as explained in the following paragraphs.

The United States law of 1866 defines the meter in terms of the inch, the equivalent being 39.37 inches. This inch is the inch of England, which is thus made the fundamental standard of the United States by statute law, as it has been under common law since the first English settlement in 1607.

STANDARDS OF WEIGHTS AND MEASURES FIXED BY CONGRESS.

To make this perfectly clear we shall quote the law on this subject. To begin with, we find the following passage in the Constitution of the United States: "The Congress shall have power to * * * fix the standards of weights and measures."

We quote the metric law as enacted by Congress July 28, 1866. (From Federal Statutes, annotated, vol. 9, p. 1401.)

STANDARD WEIGHTS AND MEASURES.

"SEC. 3569. *Use of the metric system authorized.*—It shall be lawful throughout the United States of America to employ the weights and measures of the metric system; and no contract or dealing, or pleading in any court, shall be deemed invalid or liable to objection because the weights and measures expressed or referred to therein are weights and measures of the metric system.

"SEC. 3570. *Authorized tables of weights and measures.*—The tables in the schedule hereto annexed shall be recognized in the construction of contracts, and in all legal proceedings, as establishing in terms of the weights and measures now in use in the United States, the equivalents of the weights and measures expressed therein in terms of the metric system; and the tables may be lawfully used for computing, determining. and expressing in customary weights and measures the weights and measures of the metric system."

Measures of length.

Metric denominations and values:		Equivalents in denominations in use.
Meter	inches	39.37
Decimeter (1/10 meter)	inches	3.937
Centimeter (1/100 meter)	inches	.3937

To bring out more fully the intent of section 3570 we requote it in the following abbreviated form:

"The tables * * * shall be recognized * * * as establishing the terms of the weights and measures now in use in the United States, the equivalents of the weights and measures expressed therein in terms of the metric system."

Here the "inch" is taken as fundamental. the meter being expressed in terms of the inch. Clearly the object of this law was not to change our basic units but to make the use of the metric system permissible. This is further evidenced by the title of section 3569 which reads: "Use of the metric system authorized," and by the expression in the section reading: "It shall be lawful throughout the United States of America to employ the weights and measures of the metric system."

In spite of the fact that the law quoted on this subject is very clear and explicit. the impression has been spread throughout the United States and also abroad that the meter and not the yard is the legal standard here. We find statements to this effect even in standard engineering handbooks, such as, for example, Handbook for Electrical Engineers, by H. Pender, published by John Wiley & Sons (see p. 1752 of the 1917 edition).

In a circular letter mailed recently (Sept. 26, 1921) by the Netherland Engineering Standardization Committee, Delft, Holland, to all the national engineering standards associations there appears the statement:

"There is a difference between the English and the American definition of the yard. In England the yard is prime standard and the relation between yard and meter has been fixed legally in such a way that 1 inch in England equals 2.539998 centimeters."

"In America the meter is prime standard and the yard has been legally defined in such a way that one inch in America equals 2.540005 centimeters."

This misapprehension regarding the identity of the inch in England and the United States has become world-wide, a recent manifestation of it being an article by Sir J. E. Petavel, director of the National Physical Laboratory, Teddington, England, and published in London on January 8, 1921, in which he said:

"In America the international meter is accepted as the primary standard of length, and the yard is defined by the relation, 39.370000 inches equals 1 meter, an American inch, of course, being taken as one thirty-sixth part of this American yard. Now, the relation between the imperial standard and the international meter is 39.370113 inches equals 1 meter. Consequently, the United States of America inch is longer than the inch as used in Great Britain by nearly three-millionths of an inch."

The difference to which Sir J. E. Petavel refers is merely a difference between the bars used for comparison and results from the Mendenhall order of 1893 by which the reciprocal 3600/3937 of the legal expression 3937/3600 was

ordered for comparing United States standards (39.37 inches equals 1 meter and 36 inches equals 1 yard).

This order is quoted on page 60 of Circular No. 47 of the Bureau of Standards, Washington, D. C., under the title "The metric standards adopted as fundamental," and reads, as far as given there:

"The office of weights and measures * * * will in the future regard the international prototype meter and kilogram as fundamental standards, in accordance with the act of July 28, 1866." (Order approved by the Secretary of the Treasury, Apr. 5, 1893.)

This quotation undoubtedly gives the impression that the meter is for use in America the fundamental unit, unless one gives heed to the qualifying expression "in accordance with the act of July 28, 1866."

This act of 1866 should have been quoted in full. The title given, "The metric standards adopted as fundamental" is therefore incorrect. This order had no effect whatever on the legal length of the inch and yard. As pointed out previously, standards of weights and measures can not be changed in the slightest degree except by act of Congress.

The United States Bureau of Weights and Measures in 1893, and its successor, the Bureau of Standards, could legally conform to the Mendenhall order only as far as the bar used for comparison was concerned. Under the law and the Constitution the sworn duty of the officials of those bureaus was and is to treat any variation between standards resulting from the use of the reciprocal (3600/3937) of the legal meter as merely a variation between bars used for comparison, just as the difference between the London yard and Sevres meter or between the different meter bars are taken into account in verifying standards.

Two facts should always be kept in mind:

(1) The United States yard and the British yard are exactly the same and can be made to vary only by act of the British Parliament or by act of the Congress of the United States.

(2) The act of 1866 defining the meter as 39.37 inches established a United States standard meter differing slightly from the standard meter accepted by the International Bureau of Weights and Measures at Sevres.

The equivalent of the international meter is taken as 39.370113 inches in England, and as 39.370000 inches in United States of America; therefore the United States meter is shorter than the international meter and the difference is expressed by

$$39370000/39370113 = 0.\begin{array}{r} 99999712902 \\ 287098 \\ \hline 1.00000000000 \end{array}$$

approximately 287/100000 millimeter, or nearly 3/1000 millimeter.

This question can not be settled by asserting that the differences are negligible for ordinary measurements, and are material only when the highest degree of precision is involved. The principle is as important in one case as in the other. If it is conceded that an order of a bureau official at Washington can change the United States standard of the yard to any extent whatever, no matter how slight, then the same official can change this standard or any other standard by a larger amount.

Attempts have been made in the United States through the introduction of bills in Congress to secure the acceptance of the meter as the sole United States standard by the authority of Congress, but these attempts so far have failed. An incident of this kind is recalled by the Ashbrook-Stratton-Thurman bill of 1907, framed by the United States Department of Commerce. This bill was not passed, nor have similar bills found favor.

Owing to the prominence of Sir J. E. Petavel as director of a British national institution this matter was called to his attention, and he was quick to recognize and acknowledge the error into which he had been led, the following being his statement published in London on March 26, 1921:

"I admit that we were certainly in some perplexity as to the exact position in the United States, but our conclusion was based on the statement of the Bureau of Standards circular No. 47, quoted in this article, which statement, taken by itself, would appear to show clearly that the meter, and not the yard, was accepted in America as the fundamental standard; and we believe it is a fact that the Bureau of Standards so interprets the Mendelhall order. None the less, it certainly appears from the article that this interpretation has not legal sanction, and that therefore it is the American meter and not the American

inch which, in accordance with the law of 1866, must be regarded as slightly different from true standard.

"Yours, faithfully,

"J. E. PETAVEL, *Director.*

TEDDINGTON.

The bill (S. 2267) now before your committee again tries to legalize a practice which has no legal ground to stand on, as is shown by the facts above stated.

The publications of the United States Bureau of Standards are trying to convey the impression that of all the established standards the meter alone has a scientific character. Yet the only correct definition which can be given of the "meter" on which the metric system is based would read:

"The meter is the distance between two parallel lines on a platinum-iridium bar, a distance arbitrarily fixed, this bar being carefully preserved at the Bureau of Weights and Measures at Sevres, France. When this bar is kept at a uniform temperature of zero degrees Centigrade throughout, this distance is called the 'standard meter.'"

It is only in recent years that there has been discovered in nature a definite and immutable standard of length which can be determined with scientific precision. The wave length of the red rays of the spectrum of cadmium constitutes such a standard, and as a result it is now possible to standardize any length, whether it is the yard, meter, or other linear unit whatsoever by expressing it in terms of light waves.

Our objection to section 2 of the bill is based on—

1. Our opposition to changing the law of July, 1866. Such a change has been suggested in various bills, but was never favorably considered by Congress.

2. The enactment of this section would establish a difference in the fundamental standards as used in the United States and in Great Britain and would complicate the work of standardization for the English-speaking peoples.

PART 2.—ANSWERS TO ARGUMENTS PRESENTED BY WITNESSES IN SUPPORT OF BILL.

INTRODUCTION.

Manufacture as well as trade and commerce is now conducted on the English system of weights and measures, a system established and used since the inception of the Republic. At no time was there confusion due to the use of two or more related or unrelated systems, such as necessitated in other countries the unification of practice to a single system.

The bill distinctly demands the compulsory use of the metric system in trade and commerce and distinctly exempts from the use of this system all manufacturing activities as well as the sale and barter of land and real estate. It thus imposes on the country the use of a dual system.

In view of these facts the bill raises the question: Is the metric system sufficiently superior to the present English system to warrant its compulsory introduction by law?

The witnesses who have appeared at these hearings have presented affirmative arguments to this question. The subject thus opened is a very large one and to some extent technical in many respects. Although prepared to do so, we shall not try to cover this field, as this has been done exhaustively in "Research Report No. 42, October, 1921," just published by the National Industrial Conference Board, 10 East Thirty-ninth Street, New York City, under the title: "The Metric versus the English System of Weights and Measures," copy of which is presented to your committee for reference.

Should, however, your committee report this bill favorably to the Committee on Manufactures, we would respectfully ask for an opportunity to discuss this subject fully.

We shall confine ourselves in this part to answering the arguments presented to your committee by the witnesses in favor of the bill.

THE ARTISAN AND THE METRIC SYSTEM.

Section 8, paragraph 2, exempts manufacturers from the compulsory use of the metric system. Thus the army of artisans employed in the production

of manufactured articles will continue to use the system they are familiar with. This applies not only to the trades such as machinists, masons, carpenters, pattern-makers, blacksmiths, electricians, tool makers, draftsmen, etc., but all those employed in the various departments of manufacturing establishments.

These men and women are also consumers. In that capacity they are forced to use the metric system because section 3 compels merchants to sell to them all goods, wares, and merchandise which are offered by weights and measures in the metric system only. But when they buy a home the title deed will give the dimensions of the property in our present English system.

This large part of the population is thus compelled to use two systems, the respective units of which bear widely varying relations to each other and where accustomed units in one are not represented by similar units in the other such as the foot, the pint, etc.

The suggestion has been made at these hearings that existing containers could be used by filling them only partially where the metric unit is smaller than the one in use. A case in point is the quart bottle for milk of which there are millions in existence. The liter is smaller than the quart and the housewife would strenuously object to a partially filled bottle which would give her no assurance of the quantity she is paying for.

The complexity thus created by the use of a dual system leads only to confusion, nullifying the claim that the use of the metric system will simplify the multiplicity of daily transactions.

THE COST TO THE ARTISAN.

The bill under consideration being (as shown in the arguments against it) only a preliminary step to the compulsory introduction of the metric system into every activity of the United States, makes it necessary to point out what the effect of such action would be on the artisans of the country.

It is customary for the classes of artisans mentioned below to personally own such measuring tools as are required for their work. Such tools graduated in one system can not be changed to read to a different system. Hence they would have to be replaced, the cost of this change falling on the individual.

Below is given the approximate cost this change would place on individuals of various trades. The figures are based on prewar prices and are in all cases a minimum.

Mason	$2.50	Machinist apprentice	$4.85
Carpenter	7.25	Tool maker	32.60
Pattern maker	9.65	Sheet-iron worker	4.75
Blacksmith	2.50	Draftsman	2.90
Machinist	28.00		

What the aggregate cost to the workman of this country would be can be surmised from a statement by Mr. E. F. Dubrul, general manager of the National Machine Tool Builders Association, under date of November 15, 1921, from which we quote:

"There are 400 machine tool manufacturers, large and small, in this country. * * * These men at the height of the war employed something like 72,000 workmen, practically everyone of whom was concerned with the measurement of the work he was doing from day to day. If the average investment of these workmen were only $10, and we think it would be more, we can see that in this relatively small industry alone, metric advocates would put a burden on these men of $720,000."

THE HOUSEHOLD COST OF CHANGING TO THE METRIC SYSTEM.

While the 1920 census has not yet been completed, conservative estimates place the population of the United States at about 110,000,000.

An analysis of previous enumerations has shown that the rate of male to female population is 49 males to 51 females. On this basis the female population would be 56,100,000. From a study of the returns it appears that about 60 per cent of this number are classed as married women, their number therefore, would be 33,660,000, each one of them being a center of a household.

Allowing for widowhood, separation, etc., we may safely count the households or homes in the United States at 28,000,000.

Every household will have and use at least—

1 tape measure	$0.15–$0.25
1, 4, or 6 foot rule	.25– .50
1 kitchen scale	2.50–10.00
	2.90–10.75

These measuring tools are graduated to our established system of weights and measures. They can not be changed to read to the metric system, they must therefore, be replaced.

If we figure the minimum cost thus imposed on every household as only $1.50, thus making more than ample allowance for cases where these appliances are missing, we arrive at the very considerable figure of $42,000,000.

This expense would be a complete monetary loss because the substitution of metric units would not bring anything of value to the home, whatever advantages might be claimed for that system as applied to scientific calculations.

It further involves the necessity of educating this vast number of persons to the use of the new system. The passing of a metric bill will not accomplish this.

THE FARMER AND THE METRIC SYSTEM.

The farmer, though by nature conservative and cautious, is ready to consider improvements. But very strong and convincing arguments are needed to induce him to abandon methods and traditions which in the past have served his purpose.

The possibility of the change therefore from the established system now everywhere in use in the farming districts to the metric system depends on whether such a change is to the farmer's decided advantage. Theoretical and scientific considerations will have no weight with him. Due to his deliberate manner in approaching innovations, compulsion is bound to be distasteful to him.

One of the units best known and in use with the farmer, which he would be asked to discard should this bill be favorably considered, is the bushel. Mr. Hubbard, representing the Bureau of Standards at these hearings, objected to this unit on the ground that there are now in use over 60 different kinds of bushels. This statement is in error. There is only one bushel in use all over this country; it is a container having a capacity of 2,150.42 cubic inches. This unit is to be replaced by the hectoliter. When a bushel is filled with a certain commodity the quantity so measured will have a certain weight. When filled with a different commodity it may have a different weight. This equally applies to the hectoliter and would also apply to the suggestion made at these hearings that the bushel should be replaced by the expression 35 liters, one bushel being equal to 35.238 liters, an expression which would introduce an unhandy designation foreign to the decimal nature of the metric system, requiring a calculation every time more than one bushel is under consideration.

Among farmers the practice has developed and is gaining ground to sell their commodities by weight. Many States by law have established for different commodities fixed relations between volume and weight based on the bushel as a unit. These relations would have to be reestablished on a metric basis, the metric system would therefore not do away with this condition.

When we consider the metric units available to take the place of the bushel we have the hectoliter and the decaliter. In the table shown herewith are given the weights for different commodities based on these metric units both in metric and English weights as well as the prevailing weights per bushel. The weights per bushel given are those legally defined by various States as shown in pamplet C–10 of the Bureau of Standards.

	Bushel.	Hectoliter.		Decaliter.	
	Pounds.	*Kilograms.*	*Pounds.*	*Kilograms.*	*Pounds.*
Potatoes, wheat, alfalfa seed, peas, white beans, clover seed	60	77.2	170.3	7.7	17.0
Shelled corn, rye, flaxseed	56	72.1	158.9	7.2	15.9
Carrots, millet, sorghum	50	64.4	141.9	6.4	14.2
Barley	48	61.8	136.2	6.18	13.6
Timothy seed	45	57.9	127.7	5.8	12.8
Oats	32	41.2	90.8	4.1	9.1

The products raised by the farmer run in weight from about 32 to 60 and in some cases to 70 pounds per bushel. It is significant to note that these are weights which any able-bodied man can carry conveniently. Bearing this in mind an examination of the table mentioned will readily show that the metric units are either too large or too small. They lack the essential quality of handiness, and for this reason alone will not appeal to the farmer. If, as time goes on, he finds it more convenient to sell his produce by weight only, then, no doubt, he will give up the bushel, but not before. This is a matter which can safely be left to the parties interested. It will gradually clear itself up, but will not yield to compulsion.

The farmer is a consumer as well as a producer. Everything he sells and everything he and the members of his household buy, from clothes to farm machinery, will have to be designated as to weights and measures in the metric system. When, however, he either sells or buys farmland or real estate of any kind, he will do so according to the now established English system, because the bill, in section 3, paragraph 1, distinctly specifies only the buying and selling of "goods, wares. or merchandise," thus exempting real estate, land, etc.

The bill thus imposes on the farmer, his wife, and children a dual system. Not only is he obliged to acquaint himself with both systems and the relations (so difficult to remember) they bear to each other, but he will also be obliged to use a mixture of the two systems when he figures the yield of his acres in hectoliters or kilograms.

In place, therefore, of the uniformity now existing, this bill imposes on him a mixture and conglomeration of systems and terms leading only to confusion. Moreover, the fact must not be lost sight of that the metric terms with their Latin and Greek prefixes, while to a certain extent simple and easily understood and memorized by the specially trained mind, are nevertheless confusing and hard to remember for those with only a common-school education, while no difficulty is experienced with designations forming part of the English language itself.

The findings shown in report No. 42 of the National Industrial Conference Board, copy of which has been handed to your committee for reference. are of special interest where, under the subtitle "Agriculture" (p. 69), the final paragraph reads as follows:

"As regards the use of the metric systetm, however, apparently no demand has ever developed on the part of those in the agricultural field for its adoption. The old natural units which have been employed in almost every agricultural community throughout the world have evidently been adequate for the purposes of the farmer, and the very tenacity with which he has clung to these old units in other countries may be taken as an indication of the farmer's attitude toward the compulsory adoption of the metric system in the United States. The attitude of the American farmer was evidenced in replies to the board's questionnaire inquiring into the matter. Two associations intimately connected with special branches of the agricultural field—the American Seed Trade Association and the International Apple Shipper's Association—testified to the lack of use of metric units and indicated a strong opposition to the suggested change in systems."

The bill thus imposes on the farmer hardships without compensating advantages. Neither from a theoretical or practical business standpoint have the metric advocates demonstrated a single advantage to the farmer in the adoption and use of the metric system.

THE RETAIL DRY-GOODS TRADE.

The bill imposes on this trade the following burdensome requirements:

(1) All measuring devices, principally measures of length, are to be replaced by metric measures. As such devices can not be regraduated, this implies a total loss to be borne by this trade.

(2) The great number of salesmen, saleswomen, and clerks must be made proficient not only in the use of the metric system but also have a complete knowledge of equivalent values to be able to translate quickly from one system to the other.

This is necessary for the reason that the customers will insist using the units they are accustomed to.

(3) The merchants will be obliged to accept domestic-textile goods folded to the yard, though billed to the meter (as will be shown below). Foreign textiles will be billed by the yard.

The receiving, inspecting, accounting, and billing departments will have to be reorganized to deal with the use of a dual system.

THE METRIC SYSTEM.

WEDNESDAY, DECEMBER 14, 1921.

UNITED STATES SENATE,
SUBCOMMITTEE OF THE COMMITTEE ON MANUFACTURES,
Washington, D. C.

The subcommittee met, pursuant to call, at 11 o'clock a. m., December 14, 1921, in the committee room, Capitol.

Present: Senator Charles L. McNary, chairman.

The CHAIRMAN. We will resume the hearing on Senate bill No. 2267, to fix the metric system of weights and measures as the single standard of weights and measures for certain uses.

STATEMENT OF MR. C. C. STUTZ, SECRETARY AMERICAN INSTITUTE OF WEIGHTS AND MEASURES.

The CHAIRMAN. State your full name, address, and occupation.

Mr. STUTZ. C. C. Stutz, 115 Broadway, New York City; secretary American Institute of Weights and Measures.

The CHAIRMAN. You appear in opposition to the proposed legislation?

Mr. STUTZ. Yes, sir.

The CHAIRMAN. Proceed in your own way.

Mr. STUTZ. I have prepared, as secretary of the American Institute of Weights and Measures, a brief which we would like to have made a part of the record.

The CHAIRMAN. You have condensed there practically all that you have to say with regard to your opposition to this bill?

Mr. STUTZ. Yes, sir.

The CHAIRMAN. And you desire it incorporated in the record as part of your statement?

Mr. STUTZ. Yes; I would like to have that go in the record.

(The brief referred to is here printed in full, as follows:)

DATA AND ARGUMENTS IN OPPOSITION TO BILL S. 2267, RESPECTFULLY PRESENTED BY AMERICAN INSTITUTE OF WEIGHTS AND MEASURES, C. C. STUTZ, SECRETARY.

STANDING OF THE AMERICAN INSTITUTE OF WEIGHTS AND MEASURES.

The American Institute of Weights and Measures, represented at these hearings by its secretary, was organized for the purposes of defending the existing American system of weights and measures against prometric propaganda, and to study and advocate such coordination and simplification of the existing system of weights and measures that might appear to be desirable.

The organizers of the institute comprised a group of important industrialists who appreciated the gravity of unwise attempts to disturb the existing system of weights and measures. Immediately following the organiaztion of the institute accessions to membership became rapid and at the present time the list of members comprises 566 supporting corporations, partnerships, and individuals, mainly manufacturers, employing an aggregate of over 500,000 persons.

Expressed in metric terms this table would now read:

	When the minimum carload weight provided in the classification for the article shipped is—						
	8,163 kilograms.	9,070 kilograms.	9,979 kilograms.	10,887 kilograms.	11,795 kilograms.	12,701 kilograms.	13,608 kilograms.
	Kilograms.	*Kilograms.*	*Kilograms.*	*Kilograms.*	*Kilograms.*	*Kilograms.*	*Kilograms.*
Charge not less than	8,410	9,344	10,279	11,213	12,147	13,081	14,016
Do	8,654	9,616	10,578	11,540	12,501	13,494	14,424
Do	8,899	9,888	10,877	11,866	12,855	13,875	14,833
Do	9,144	10,161	11,177	12,192	13,209	14,225	15,136
Do	9,553	10,614	11,676	12,737	13,798	14,860	15,921
Do	9,961	11,068	12,175	13,281	14,388	15,505	16,602
Do	11,594	12,882	14,171	15,459	16,747	17,625	19,323
Do	13,227	14,697	16,166	17,636	19,106	20,575	22,045
Do	16,330	18,144	19,958	21,773	23,587	25,401	27,216

This is only one of a great number of examples which could be quoted. In view of such facts, it is not surprising that the American Railway Association, whose eight divisions cover every phase of the railroad problem, has gone on record as opposed to compulsory metric legislation. The resolution passed by this body, speaking for practically the total mileage of the United States, is given elsewhere.

GROCERS.

Mr. A. P. Williams, president Wholesale Grocers' Asssociation, has conveyed the idea that the grocery trade is a unit in favor of this bill. We quote from an editorial of the monthly publication, Grocers' Magazine (Boston, Mass.), issue of October, 1921:

"Numerous organizations in the grocery trade, first and last, have passed resolutions condemning laws put forth by the metricites, while other organizations, fooled by faddists, have indorsed the metric system."

FOREIGN TRADE.

Witnesses have claimed that compulsory metric legislation was necessary in order to help us obtain foreign trade. Inasmuch as the bill exempts export trade from its provisions, no argument would seem to be necessary.

We thoroughly agree with one of the witnesses for the metric side when he stated that, in his opinion, the use of the metric system had absolutely nothing to do with export trade and was not a factor in promoting it. The foreigner will buy the cheapest goods consistent with quality, the best machines, irrespective of the system they were manufactured or built to, provided many other conditions allow him to do so. Among them are exchange and credit conditions, tariffs, freights, deliveries, etc.

These facts are well known to your committee, dealing, as you do, with legislation affecting commerce and export trade.

EDUCATION.

Witnesses have testified that anybody able to read and write can learn the metric system in half an hour's time and even less. Others have designated longer periods. Several have insisted that much time could be saved in education by the exclusive use of the metric system in the schools, this time being variously estimated up to one and a half years.

To the specially trained mind, the product of a high school, college, and university, the acquisition of a knowledge of the metric system will present no difficulties. With the great mass of the buying population, those of 10 years of age and up, having only a common school education of which about 37,000,000 are employed in gainful occupation alone, this matter takes on a different aspect. To them metric terms with their Latin and Greek prefixes are words of a strange language and to fix them even partially in their minds will require painstaking efforts over long periods. The sincerity of the witnesses is not in

doubt, they believe their statements. The trouble is, having a scientific training, they can not imagine themselves in the position of a person limited by a common-school education, imperfect as this often is.

The statement that the adoption of the metric system would dispense with the teaching of common fractions or denominate numbers in schools, a subject troublesome to many, is on its face untenable. No argument is needed to show that arithmetic, the foundation of mathematics, can thus be thrown into the discard, even when considered only from the standpoint of the common school.

The bill specifically imposes on the people a dual system, the simultaneous use of two systems unrelated to each other. This, in turn, imposes the necessity of becoming familiar with the relation existing between units of the two systems, commonly called conversion factors. There are two sets of these factors, one set for each system. Take as an example the unit of weight. We must know that 1 pound equals .4536 kilograms and that 1 kilogram equals 2.2046 pounds.

Granted that a certain time is required to teach in schools our existing system of weights and measures. Granted also that a certain time is needed to teach the metric system. Additional time must then be devoted to fix in the mind more or less accurately the interrelations between the two systems. Now, it is axiomatic that the sum of two or more similar values is greater than the value of any one of them. Therefore, this bill would not decrease but increase, we claim materially increase, the time and effort required in the education of the school child.

TEACHERS AND EDUCATORS.

Witnesses have maintained that the teachers in our schools are all in favor of replacing our present system with the metric system, one of the main reasons advanced being that in so doing their labors would be reduced.

Even if this were the case, the larger question of the best interests of the community at large remains of greater importance. The opinions expressed below by some well-known educators cover this aspect of the matter:

"I feel that college men who had no experience outside of the college and laboratory perhaps do not appreciate the situation regarding matters of weight and measurement. It is the manufacturers who come up against the real tests. Having had wide experience as an engineer, manager of industrial plants, and as a consulting engineer, I feel that I am competent to look upon the practical side and my opinion is, without qualification, that a compulsory law in favor of the metric system will be a fatal mistake and would place upon the industrial interests of the United States a tremendously heavy and unnecessary burden which would, at this time in view of foreign competition, be particularly inexpedient. It would involve the expenditure of millions and millions of dollars and instead of helping us with regard to exports, it would be hurtful.

"To representatives of educational associations and institutions who may have been led into an indorsement of the metric program, I would say that while naturally appealing to the workers in the laboratory as I am in a position to appreciate, I feel sure that to make a metric law compulsory would be a great misfortune to this country." (Dr. Alex. C. Humphreys, president Stevens Institute of Technology.)

"My college enthusiasm for the metric system did not survive my employment as an engineer in Germany, the chief metric country; I found that the metric system was not in universal use there after a generation of compulsory legislaion and also found the use of the metric system of no advantage in engineering computation.

"Further careful study for years has convinced me that the fancied logical advantages of the metric system are illusory and that the agitation in favor of its adoption is harmful to American industry and to engineering education." (Thomas E. Butterfield, associate professor, mechanical engineering, Lehigh University.)

"There is, I believe, a mistaken feeling that college officials and professors can be expected to favor the metric system and urge its adoption in this country to the exclusion of our established system of weights and measures. Such a feeling may exist among those who have not had practical manufacturing experience, but on the part of professors of mechanical engineering and those

who are familiar with the needs of our factories, I believe there is a strong sentiment against a change. Further, I feel that it is distinctly hurtful to instill into the minds of college students ideas favoring a change in our basic standards which later experience in practical work makes it necessary to revise.

"Colleges and universities should make every effort to cooperate with manufacturers instead of promulgating radical ideas which will 'throw a monkey-wrench into the wheels of industry.'" (L. P. Breckenridge, professor mechanical engineering, Yale University.)

THE MANUFACTURING CHEMIST.

In the working out of a chemical problem to its commercial conclusion two general groups of men are concerned:

The research or laboratory chemists.

The plant or production chemists.

The former deal with small quantities of weight and volume, very rarely with dimensions of length. As a general rule they employ only the two metric units, the cubic centimeter and the gram, as suited to their purpose.

The second group use dimensions of length, weight, volume. They deal with machinery of infinite variety and use the English system of measurements as best suited to their work.

We quote from a letter of a research chemist having years of laboratory and plant experience, as follows:

"After a process has been developed and perfected in the research laboratory it must be introduced into the plant. The operations in chemical plants, as in other plants, are carried out according to the English system of weights and measures. Materials are weighed in pounds and tanks are gauged in feet and inches.

"It might seem as if the conversion of laboratory recipes expressed in grams and cubic centimeters to plant recipes would cause a great deal of confusion. Such, however, is not the case. Take, for example, the manufacture of coal-tar dyes. The processes are highly technical and successful plant operation requires very close cooperation between the chemists in the research laboratory and the operating supervisors in the plant. This should, therefore, afford an excellent opportunity to study the conversion of laboratory recipes given in the metric system into plant recipes expressed in the English system.

"The actual weight of any chemical taken is directly proportional to its molecular weight or to some simple multiple of it. Furthermore, the volumes in the plant recipes are expressed in pounds of water. It might be expected that gallons would be used, but experience has shown that it is much simpler to calibrate all tubs, tanks, etc., in 'pounds per inch' instead of 'gallons per inch.'

"After a careful study of the question based on years of experience, the writer can state positively that he knows of no instance in which there has been any confusion, any delay, or any 'lost motion' caused by the conversion of the metric units in the laboratory recipe to the English units in the plant recipe. And, therefore, because of the convenience of the English units in plant operations, the use of the metric system should not be made compulsory." (I. E. Knapp.)

In 1917 the American Institute of Weights and Measures made a canvass by mail, addressed to manufacturing chemical concerns, to determine in how far the metric system was used in their factories. Twenty-one replies were received, showing that the metric system is used not at all by 19, slightly by 1, extensively by 1.

EFFECT OF BILL ON FIRE INSURANCE.

Fire insurance companies are calculating premiums to be charged in such a manner as to evenly balance them against the hazards incurred and to assure to themselves an adequate return for the service rendered. This implies a careful study of conditions and has led to the formation of associations of experts such as the "Fire Prevention Boards" and the "Fire Underwriters," whose business it is to so guide and if necessary restrict activities by rules and regulations as to minimize fire risks.

These bodies having to deal with building construction and the many mechanical requirements of same cover essentially a wide technical field. The rules formulated by them are numerous and often complex and are contained in what is known as the "Underwriters Specifications," compliance to which entitles the insured to favorable rates.

In looking through the underwriters specifications one at once is made aware of the definite use of units of length, weights, and volume. Minimum sizes of doors are given in feet and inches, thicknesses of walls in inches, stresses in pounds per square inch for all kinds of materials, floor loads in pounds per square foot, capacities of fire pumps in gallons per minute at prescribed pressures in pounds per square inch, etc.

Inasmuch as the hundreds of articles mentioned in these specifications can only be bought, according to this bill, in metric designations, it follows that these rules will have to be rewritten and revised to fit new standards which may have to be established.

This will lead to confusion and misunderstanding.

THE MACHINE TOOL BUILDER.

While the bill leaves manufacturers free to use the present system, it imposes on the country the use of a dual system which is even worse than compelling the universal use of the metric system, to which goal this bill is paving the way.

To a letter recently received from a prominent Cincinnati firm was attached a comprehensive report, giving a cost estimate covering such a change to the metric system. From this letter, written by the president of the company, we quote the following:

"This report was made up very carefully, and the result is simply astounding. The cost would amount to confiscation of profits for many years to come, if they were years of normal profits."

From the report which it took weeks to prepare we quote these figures:

Cost estimate.

Remaking all drawings	$36,000
Changing of patterns	12,000
Cost of new metric small tools and measuring tools	27,500
Cost of changing jigs and fixtures (about 75 per cent of the cost of these if they were all to be made new)	130,500
Change in machine tool equipment	19,000
Cost of training employees to use metric measuring tools	15,000
Cost of extra spoiled work from change:	
First year	20,000
Second year	10,000
Additional labor required due to reduction in efficiency:	
First year	40,000
Second year	20,000
Changing production and stock-room records to conform with metric units	11,000
	341,000

"The changes in jigs and fixtures would cover the full line of machines produced. The figures given cover only the engineering and production expense, no estimate of the cost to the accounting and selling departments has been made. No charge has been made for extra room to carry additional tools and repair parts built to the present system."

COST TO MANUFACTURING CONCERNS TO CHANGE TO THE METRIC SYSTEM.

Below are listed the replies from 31 manufacturing concerns to the question asked by the American Institute of Weights and Measures: "What would be the expense to your company to change from the English to the metric system?"

The original replies are on file in our office and are at the disposal of the committee on request.

State in which located.	Number of workers.	Estimated cost.	Cost per worker.
Ohio	2,500	$474,000	$190
Pennsylvania	750	218,500	291
New Jersey	900	900,000	1,000
	250	225,000	900
Pennsylvania	425	42,500	100
New York	347	52,000	150
	60	10,600	177
Pennsylvania	40,000	5,000,000	125
Ohio	260	100,000	385
	500	250,000	500
Michigan	400	150,000	375
Ohio	285	50,000	175
	250	341,000	1,365
	125	45,068	360
New York	300	120,000	400
Ohio	1,500	1,385,020	923
Michigan	15,000	2,250,000	150
Massachusetts	45	5,000	111
Ohio	200	40,000	200
New York	750	600,000	800
Pennsylvania	200	100,000	500
New Jersey	7,500	2,717,000	362
Michigan	6,000	3,000,000	500
Ohio	1,000	200,000	200
Michigan	10,412	2,500,000	240
Pennsylvania	3,100	200,000	65
Missouri	8	15,000	1,875
Connecticut	200	150,000	750
New York	800	160,000	200
Pennsylvania	250	100,000	400
Massachusetts	75	64,000	853

Summary.

Aggregate cost to 31 concerns	$21,464,688.00
Average cost per concern	$715,489.60
Workers employed by 31 concerns	94,392
Average cost per worker	$227.40

THE METRIC EQUIVAENT SCHEME.

The suggestion made by a witness before this committee, Mr. T. H. Miller, of the DeLaval Separator Co., that we make no change in existing standard sizes, but keep them as they are and measure them in metric units, has followed the demonstration of the prohibitive cost of changing these sizes (see paragraph elsewhere on cost of change) which, before that demonstration, the metric party had ignored. It is thus a reply to our strongest objection.

Every country that has, in form, adopted the metric system has had the opportunity to use this plan, since, if it is applicable to the English system, it is equally applicable to others, and had it been so applied the old systems would have disappeared, the metric system becoming, in effect, the numerical solvent of them all. There is no such result. Investigations that have been in progress for 20 years, of which that of the National Industrial Conference Board is the most recent and complete, have reached into every quarter of the globe, but they have failed to discover a country in which the plan is in use. Standard sizes based on old units are found in use in all so-called metric countries and these are always measured in the old units—never in metric units. As a way of escape of the complexities of a dual system, of which it is now offered, some countries somewhere should exist in which it has been used. The fact that no such case can be found is of itself sufficient to show its impracticability.

A Belgian engineer to whom this scheme was suggested of changing from one system to another by simply using equivalent values as advocated by this witness had this to say about it:

"We find, furthermore, that in mechanics and in general industrial constructions we have been forced to apply very often indeed the English units of measurement.

"We wish to cite as a typical example the manufacture of artillery material of which several large Belgian concerns have made a specialty, espe-

cially in the manufacture of numerous pieces demanding great precision in the machining of their parts. It has been found that it was practically impossible to transpose foreign measures into metric measures and vice versa without creating differences which, though small as they are, are sufficient to prevent the proper functioning and adjustment of these pieces. There remained, therefore, only one way open; this was to machine the material according to measuring instruments adopted by the countries which intrusted their orders to us."

CONVERSION FIGURES.

The bill as shown would impose on the people a dual system, the metric for trade, the English for manufacture. A witness has stated that it would be a simple matter to place before the farmer a little table showing the values of similar units and so familiarize him with the metric system. The same we presume would have to be done with everybody else.

Such tables have been prepared by the Bureau of Standards and are found in its Circular No. 47. While they cover here 45 pages printed in small type, they are very far from being complete. Furthermore, not a single table is found giving the conversion of compound figures such as pounds per square inch, pounds per bushel, bushels per acre, and a score of others to show what their metric equivalents would be and vice versa.

The "little table" mentioned above would grow into a fair sized book, very convenient for scientists, mathematicians, and engineers, but of little use to the average person who would simply be confused in trying to use it. It thus would tend to complexity in place of simplicity.

Mention must here be made of the necessity of rewriting the accumulated amount of technical literature, the recalculating of a mass of tables now in daily use by engineers in every field.

Existing catalogues will have to be discarded, rewritten, and replaced. This item alone represents an amount of labor and cost impossible to estimate.

These far-reaching consequences of the bill carry with them no compensating advantages. They are not justified.

FRAUD.

A witness, Mr. McFaren, argued at length that our established system lent itself most readily to fraud, was so used, and should for that reason be replaced by the metric system. Our system, having been evolved to meet the requirements of daily life, would long have ceased to exist if such a charge could be maintained. Existing rules and ordinances fully safeguard the individual.

Should this bill become a law, and so impose on the people a dual system, there would be greater opportunities for fraud due to the ensuing confusion. Such fraud can not be charged to either system as such.

THE USE OF THE TWO SYSTEMS IN CALCULATIONS.

The witnesses have had inserted into the record of these hearings some lengthy calculations to show that such calculations can be made easier in the metric system.

One of the examples given deals with the calculating of a tank of water. The result obtained, however, is only true provided we fill the tank with "chemically pure" water and have this water at the temperature of its greatest density, a few degrees above freezing.

But exactly the converse can be shown by other calculations. A simple example will suffice. What is the number of teeth in a spur gear 9 inches pitch diameter and 8 diametral pitch?

In the English system we have: Number of teeth$=9\times8=72$.

In the metric system we have: $9''=228.6$ mm.

Equivalent to 8 diametral pitch equals metric module 3.175 mm.

Number of teeth: $228.600\div3.175=72$.

Draftsmen in a manufacturing concern are always computing weights, strengths, and costs. Suppose they consider a rail or rod of iron having a cross section of 8 inches, what would be its weight per yard? An inexperienced man would multiply by the weight per cubic inch and so obtain the result. The experienced man knows that ten times the area of cross section of wrought iron is the weight per yard in pounds exactly.

Above 4 inches the millimeter always requires at least three figures, and above 40 inches at least four. This results in the average case of calculation in fewer figures with the English system.

We do not deem it necessary to burden the record with other calculations. Needless to say, many more could be given.

JAPAN AND THE METRIC SYSTEM.

Mention of Japan is made on page 76 of the record. Japan, which heretofore has had its own system of weights and measures, recently decided to change to the metric system. There was a division of opinion in Japan.

Our comments on this action is best expressed in quoting remarks contained in a letter from a very well-informed correspondent in Japan, a citizen of that country.

"Japan is a peculiar country. At present it has no distinct system of weights and measures and no definite standards, different kinds of weights and measures being intermingled throughout the country. Among practical and industrial engineers the English system was generally adopted and with much convenience. But among theoretical engineers the metric system was mostly used. Teachers in the schools taught both systems, and so on.

"In the recent discussions the practical men urged the English system, especially an improved English system. Government officials and professors in the Imperial University agreed as to the advisability of this. However, the special committee on weights and measures appointed by the Government decided to adopt the metric system, and finally the measures were passed by the two houses—Peers and Commons. The majority of this special committee consisted of old men, and of men who had been educated chiefly in Germany, and who almost worshiped everything German. This was influential in leading to the decision.

"Although, however, it will be attempted to make the metric system compulsory in Japan, and the law so provides, it is doubtful whether such a result will happen.

"Almost everything in this world develops from actual necessity. In the long run the most useful system will survive. If the leading nations of the world, which are America and Great Britain, to which Japan owes most of her civilization, business methods, etc., decide to retain the English system of weights and measures with some improvement it is certain that Japan will continue to use the English system out of considerations of actual necessity, without regard to the law, which will be practically ineffective."

In berating the English system the metric advocates never fail to mention units which have become obsolete by disuse as present-day parts of the system. The elimination of these parts is referred to by the correspondent when he speaks of "an improved English system."

CURRENCY.

Several witnesses have compared systems of weights and measures with systems of currency. Such a comparison is beside the point. The former actually measure and define physical properties, while the latter are used to simply place values on commodities and then compare them, no physical measurement of values being possible except in mediums of exchange, such as gold and silver. Even here the purely decimal notations do not answer to the requirements of trade. Price quotations for securities are given on all our stock exchanges, not in decimals of the dollar, but in denominate fractions.

A discussion of systems of currency is not germane to a consideration of this bill, because this topic is not mentioned in same. No further answer is therefore required.

THE CHARGE OF IGNORANCE.

From a paper submitted by one of the witnesses, Mr. D. A. Molitor, and forming part of the record we quote the following two passages:

Page 68. "Antagonistic public opinion brought about by unwarranted efforts on the part of some manufacturers * * * prompted largely by gross ignorance of the whole subject, is distinctly harmful * * *."

Page 70. "The exclusive use of the metric system in workshops has always resulted in immense benefits."

Companies who have installed the metric system, used it for years, and then found it necessary to abandon it and return to the English system can hardly be charged with ignorance concerning it. Nor would they have done so to sacrifice "immense profits." Such an example is the "Library Bureau," makers of office furniture, filing systems, etc. They abandoned the use of the metric system after giving it a trial of more than 30 years.

Another example is furnished by the Willans Works of the English Electric Co., Ltd., Rugby, England. We quote from a letter published in Machinery, October, 1920, written by Mr. H. F. Hemmings, works manager:

"It is not possible to use the metric system in this country to the exclusion of the inch system. Even at Rugby, where a determined effort has been made to make the metric system a commercial success, it has been found quite impossible to eliminate the inch; consequently both systems exist side by side and a double stock of precision and other tools has to be carried at considerable expense. Our experience at Preston and Stafford is the same.

"It was considered that it was not a commercial or practical proposition to work with both systems, and of the two systems the committee was of the opinion that the English was the preferable one, so far as the products of the various works of this company were concerned."

OFF-HAND DECISIONS OF LITTLE VALUE.

One of the witnesses before this committee, Mr. A. P. Williams, presented for insertion in the record (p. 134) the action taken by the City Council of Chicago in passing a resolution asking for compulsory metric legislation. It was passed by a vote of 66 in favor with none against it.

This resolution was referred to the committee on judiciary; no hearings were advertised or held; nobody interested in such action for or against it, except the promoters of the resolution, were aware of what was contemplated. The passage of this resolution without study or debate seemed to be news to everybody in Chicago. It was widely advertised, and the Bureau of Standards wrote a letter congratulating the city council. This letter is not given in the record, but is printed in the proceedings of the City Council of Chicago.

This happened in May, 1920. In the fall of the same year a similar resolution was presented to the Board of Aldermen of the city of New York and referred to the committee on markets, Alderman Dunn, chairman. He was urged by its promoters to report it promptly and favorably. These proceedings having come to the attention of the American Institute of Weights and Measures, Alderman Dunn was asked to study the question and consult with city departments affected by such proposed legislation. Publicity was given to the question, with the result that both sides could express their views to the committee. This resolution has since been tabled without action on the ground that the board of aldermen did not feel competent to pass on this matter.

The question involved is too important and far reaching to be dismissed without careful study and consideration. This fact is emphasized in the letter herewith quoted in full:

THE HADLEY CO.,
JEWELRY AND METAL SPECIALTIES,
Providence, R. I., November 25, 1921.

MR. LUTHER D. BURLINGAME,
Brown & Sharpe Manufacturing Co., Providence, R. I.

DEAR SIR: Some time ago I signed one of the cards sent out by the World Trade Club of San Francisco, expressing myself as being in favor of the adoption of the metric system by this country. Since that time I have been completing the equipment and organization of a factory in England, which I am now operating. My illusions in regard to the benefits that would accrue from the adoption of the metric system are entirely dispelled, and I personally feel convinced that the change would be one that could only appeal to theorists. My own experience in changing over—with American machinery—to a country where both English and metric measure are used, has given me some idea of the problem this country would face if a change in the standard of measurement were made. While the advantage of moving a decimal point is still attractive, I feel certain that the only practical time for the change was about the same year as the American Revolution.

Trusting that this may in some small measure have its effect in preventing what would certainly be chaos in American engineering, I beg to remain,

Faithfully, yours,

A. HADLEY.

EXISTING DEMAND FOR METRIC SYSTEM.

Witnesses before your committee have claimed a wide demand for metric legislation.

The numerical strength of the metric advocates is considered on pages 118 and 119 of Report No. 42, just published, by the National Industrial Conference Board, copy of which has been presented to the committee for reference.

The figures given are based on the Census of 1910 and are stated as follows:

Seventy-one million five hundred thousand represent the number of persons 10 years of age and over, most of whom are affected by the use of weights and measures as the buying and traveling public.

Six hundred thousand represent science, engineering, foreign and wholesale trade. These are the only fields interested to any extent in seeing the metric system adopted in the United States.

Six hundred thousand is 0.839 per cent of 71,500,000, or less than 1 per cent.

This minority recruits its numbers mainly from scientists, pharmacists, some engineers, laboratory chemists, physicians, and a number of enthusiasts who, carried away with the alluring idea of universal uniformity, have taken metric arguments for granted and deemed the study of the practical application of the metric idea superfluous. They are strongly supported by the United States Bureau of Standards, thus giving them a certain prestige as shown by its witness before this committee, Mr. Hubbard, secretary of the bureau. Thus, this bureau, while created to be of service to the people as a whole, has aligned itself on this question in a partisan way on the side of a very small minority against the interests of the great majority of our people.

SHOULD WE ADOPT THE METRIC SYSTEM BECAUSE OTHER COUNTRIES HAVE DONE SO?

Several witnesses have pointed to the fact that many countries have passed compulsory metric legislation to sustain their contention that this country should do the same.

A proper answer to this argument is contained on page 42 of the report issued by the National Industrial Conference Board, from which we quote:

"The situation in the United States, however, is to-day quite different from the situation that confronted other important countries in making a change from their local systems to the metric. In other countries considerable confusion of weights and measures existed at the time the change was brought about. In other countries, also, the change took place before the industrial life of the nation had become organized and standardized to the extent that modern production makes necessary. The countries outside of Europe which have adopted the metric system have little or no organized industries in the modern sense.

"In the United States to-day there is, in the first place, no fundamental confusion with respect to weights and measures. Furthermore, the United States unquestionably stands in the forefront of the great industrial and manufacturing nations. Its highly organized industry is based on the English units of weights and measures and most of its vast technical literature is written in this system. All things considered, therefore, there does not exist in this country the great incentive to a change found in other nations where confusion was the rule until the metric system was adopted.

"In consequence the situation to-day narrows itself down to the question whether the advantages to be gained warrant the compulsory adoption of one unified system, namely, the metric, in the place of another unified system, namely, the English, which latter is moreover the established system and enters so intimately into the present industrial organization of the Nation."

As bearing on this question we quote from a statement of a Belgian engineer given in June of this year, of which the following is a translation:

"A radical change in the order of ideas (as concerns a system of measurement) is proportionally difficult as a country is large and its industries developed. The consequences of such a change would translate themselves into a complete disorganization and entail expenses which probably no country could possibly afford. In summing up our observations, we can say that Belgium seems to be the place where one can best realize the importance of conserving a system of measurements which has been adopted for a long number of years, and where one can realize the difficulties which are created by the necessity to use several unrelated methods for measurement."

PREVIOUS METRIC BILLS.

The statement was made at one of the early hearings (p. 49 of the record) that a metric bill had once passed the House. As far as we have been able to ascertain, such a bill has never passed either the House or the Senate.

The incident to which reference was made is covered by the following memorandum:

"In the House of Representatives, April 7, 1896. Stone metric bill (H. R. 7251) called up in the House. Congressman Otey of Virginia makes a humorous speech in opposition to the bill, setting the House in a roar of laughter. Congressman Joseph W. Cannon opposes bill. House divides and refuses to order bill to a third reading—ayes 65, noes 80. Mr. Stone moved to adjourn. Adopted—ayes 98, noes 50.

"April 8, 1896. Bill ordered to be engrossed and read a third time—ayes 119, noes 116, not voting 119. Motion to reconsider previous vote is adopted—ayes 143, noes 99, not voting 112. Mr. Stone asks unanimous consent to withdraw the bill from the House. Refused. On motion of Mr. Stone the bill is recommitted to the Committee on Coinage, Weights, and Measures—ayes 130, noes 59."

It may be noted further that the metric bill which was reported favorably to the House in 1902, and was pending in 1904, failed of passage, no action being taken by Congress.

In succeeding Congresses, subsequent to 1902, various metric bills were introduced and referred to the Committee on Coinage, Weights, and Measures. The last one, introduced by Congressman Littauer, was defeated in the committee, with only three votes in its favor. A great deal of testimony had been taken on this bill and printed in two volumes, dated 1906 and 1907, reference being made to H. R. 8988.

PART 3.—LIST OF ANTIMETRIC RESOLUTIONS PASSED BY VARIOUS PUBLIC BODIES.

NATIONAL ASSOCIATIONS.

American Boiler Manufacturers' Association; Aeronautic Division, S. A. E.; American Gear Manufacturers' Association; American Hardware Manufacturers' Association; American Railroad Association, Mechanical Section 3; American Railway Association; American Railway Engineer Association; Association of American Steel Manufacturers; Automotive Wood Wheel Manufacturers' Association; Bolt, Nut, and Rivet Institute; Bridge Builders and Structural Society; British Parliamentary Commission; Bureau of Envelope Manufacturers of America; Canning Machinery and Supplies Association; Dry Saturating Felt Manufacturers' Association; Foundry Equipment Manufacturers' Association; Hickory Products Association; Hot Rolled Strip Steel Institute; Iron and Steel Group, Chamber of Commerce, United States of America; Institute of Cold Rolled Steel; Meter Manufacturers' Exchange; Motor and Accessory Manufacturers' Association; National Association of Corrugated Fibre Box Manufacturers; National Association of Importers of Hides and Skins; National Association of Manufacturers; National Automobile Chamber of Commerce; National Automobile Dealers' Association; National Brick Manufacturers' Association; National Hay Association; National Implement and Vehicle Association; National Industrial Traffic League; National League of Commission Merchants of the United States; National Metal Trades Association; National Retail Lumber Dealers' Association; Photographers' Association of America; Range Boiler Exchange; Rubber Association of America; Rubber Association of America, Manufacturers' Division; Steel Barrel Manufacturers' Association; Society of Automotive Engineers (Inc.); American Erectors' Association.

AMERICAN BOILER MANUFACTURING ASSOCIATION,
French Lick, Ind., May 31, 1920.

We express ourselves as being strongly opposed to any legislation tending to supplant our established weights and measures by the enforced use of the metric system, and we indorse the work of the American Institute of Weights and Measures.

(Abstract from a letter by H. N. Covell, secretary and treasurer, Nov. 5, 1921:)

The active membership of the American Boiler Manufacturers' Association is 75. At the present time the members employ probably about 7,000 people.

It is somewhat difficult to arrive at the capital invested, but I think from $40,000,000 to $50,000,000 would be a conservative estimate.

The members of the association manufacture fully 80 per cent of the boilers produced in the United States.

AERONAUTIC DIVISION, S. A. E.,
June 21, 1921.

It is definitely recommended that the English system of measurement be used except in isolated cases, such as spark-plug threads, where the metric system is desirable in order to effect interchangeability with some well-established standard.

AMERICAN GEAR MANUFACTURERS' ASSOCIATION,
Boston, Mass., December, 1919.

Resolved, That the American Gear Manufacturers' Association in convention assembled, hereby declare themselves as opposed to any change in our present system of measurement.

Resolved, That a copy of this resolution be forwarded to the World Trade Club; Woodrow Wilson, President of the United States of America; British Premier, the Right Hon. David Lloyd-George; and the American Institute of Weights and Measures.

AMERICAN HARDWARE MANUFACTURERS' ASSOCIATION,
Atlantic City, N. J., October 21, 1921.

Resolved by the American Hardware Manufacturers' Association. That we favor the maintenance of our present system of weights and measures in general use and express our opposition to proposed legislation which would make the metric system compulsory and prohibit the use of our present units.

AMERICAN RAILWAY ASSOCIATION,
SECTION 3, MECHANICAL,
Atlantic City, N. J., June, 1920.

Resolved, That section 3, mechanical, of the American Railway Association is opposed to legislation making the use of the metric system of weights and measures obligatory to the exclusion of the English system or the American system at present in general use. (Voted unanimously.)

(Abstracts from a letter by V. R. Hawthorne, secretary, Nov. 7, 1921:)

Would advise that membership in the American Railway Association consists of practically all railroad mileage in the United States.

The membership in the mechanical division of the association is composed of representatives from the mechanical departments of each carrier.

AMERICAN RAILWAY ASSOCIATION,
November 17, 1920.

Resolved, That the American Railway Association hereby ratifies the action taken by the engineering and mechanical divisions in opposition to the adoption of the metric system of weights and measures to the exclusion of the English or American system at present in general use and desires to express its hearty approval of the effort which is now being conducted to combat the propaganda being waged throughout the country urging the enactment of legislation whereby the metric system would be made the sole standard of weights and measures.

AMERICAN RAILWAY ENGINEERING ASSOCIATION,
Chicago, Ill., March, 1920.

Expresses itself opposed to the adoption of the metric system of weights and measures to the exclusion of the English system or the American system at present in general use.

(Abstract from a letter by E. H. Fritch, secretary, Nov. 7, 1921:)

That American Railway Engineering Association is a technical society, its membership being composed of officials of railways connected with the engineering and operating departments.

The association has on its rolls 2,000 members, the railways represented having an approximate mileage of 300,000.

The compulsory introduction of the metric system of weights and measures would have a disastrous effect on the engineering departments of railways. Thousands of maps, drawings, and tables would have to be changed or recalculated, making the cost practically prohibitive.

ASSOCIATION OF AMERICAN STEEL MANUFACTURERS,
——— ——, *1920.*

Unanimously voted against the compulsory use of the metric system.

This association represents 84.22 per cent of the total annual steel-ingot capacity of the United States.

Members representing 96.3 per cent of the total annual steel-ingot capacity of this association voted as above.

AUTOMOTIVE WOOD WHEEL MANUFACTURERS' ASSOCIATION,
Cedar Point, Ohio, August 13, 1920.

The Automotive Wood Wheel Manufacturers' Association records its opposition to the compulsory adoption of the metric system of weights and measures, which various interests are asking Congress to legislate for. We believe that attempts to compel its adoption in the United States are unwise, unnecessary, and calculated to disturb seriously the standards of measurement now uniformly used in this industry.

(Abstract from a letter by H. A. Long, secretary, Nov. 4, 1921:)

Our membership consists of 11 companies operating about 17 factories. Our members employ approximately 15,000 employees.

The capital invested by association members is approximately $35,000,000.

Our members make approximately 65 per cent of all automotive wood wheels made in the United States.

THE BOLT, NUT & RIVET INSTITUTE,
New York, N. Y., March 17, 1920.

Hon. ALBERT H. VESTAL,
House of Representatives, Washington, D. C.:

At a regular monthly meeting, held March 17, a resolution was unanimously passed that this institute be placed on record as being opposed to any legislation with the intent of adopting the metric system in place of the United States standard system.

THE BOLT, NUT & RIVET INSTITUTE.
N. J. CLARK, *President.*

BRIDGE BUILDERS & STRUCTURAL SOCIETY,
Pittsburgh, Pa., February 11, 1921.

Resolved, That this society be placed on record as being very much opposed to any legislation providing for the adoption, gradual or otherwise, of the metric system instead of the United States standard system; and further

Resolved, That the secretary notify by letter the Senate Committee on Coinage, Weights, and Measures, and also the secretaries of the World Metric Standardization Council and the American Institute of Weights and Measures.

(Abstract from a letter by George E. Gifford, secretary, Nov. 4, 1921:)

I beg to advise that the membership of this society at present comprise 28 concerns. These are the principal concerns fabricating structural steel for bridges and buildings in the United States, outside of the American Bridge Co., subsidiary of the United States Steel Corporation. Our membership represent approximately 40 per cent of the capacity of fabricating concerns in the United States.

BRITISH PARLIAMENTARY COMMITTEE
ON COMMERCIAL AND INDUSTRIAL POLICY AFTER THE WAR,
——— ——, *1917.*

We are not convinced that the metric system is upon the whole even theoretically superior to the British system, and we are satisfied that the practical objections to the proposed change are such as decisively to outweigh any advantages which are claimed for it.

BUREAU OF ENVELOPE MANUFACTURERS OF AMERICA,
Detroit, Mich., September 27–28, 1920.

The members heartily indorsed the work of your institute for preserving the integrity of our present basic English units for weights and measures.

CANNING MACHINERY & SUPPLIES ASSOCIATION,
Atlantic City, N. J., January 21, 1921.

Resolved, That the machinery section hereby expresses itself as strongly opposed to the adoption in this country of the metric system of weights and measures, and that the chairman be instructed to forward copies of this resolution to the joint congressional committee considering this question and to the American Institute of Weights and Measures.

(Abstract from a letter by Ogden S. Sells, president, Nov. 26, 1921:)

Our association numbers among its members such concerns as the American Can Co., American Sheet & Tin Plate Co., and practically 100 per cent of the firms engaged in supplying cans, bottles, boxes, labels, machinery, and condiments to the fruit, vegetable, meat, and fish canners and preservers of the United States.

In a general way our association has about 200 members; their total employees must be upward of 100,000; the capital invested, probably $500,000,000; and 98 per cent of the particular field is covered by our membership.

DRY SATURATING FELT MANUFACTURERS' ASSOCIATION,
New York City, N. Y., March 17, 1921.

Resolved, That the Dry Saturating Felt Manufacturers' Association is opposed to the adoption of Senate bills entitled "To fix the metric system of weights and measures as the single standard for weights and measures."

(Abstract from a letter by O. L. Wetterman, secretary, Nov. 4, 1921:)

We desire to say that there are now 16 company members in this association, representing from 80 to 90 per cent of the country's production of dry saturating felt.

FOUNDRY EQUIPMENT MANUFACTURERS' ASSOCIATION,
Pittsburgh, Pa., October 28, 1921.

At a meeting of the Foundry Equipment Manufacturers' Association on October 28, 1921, upon motion, action was taken, duly seconded, and carried without dissent as being unalterably opposed to the compulsory use of the metric system in the United States.

HICKORY PRODUCTS' ASSOCIATION,
Cedar Point, Ohio, August 12, 1920.

The Hickory Products' Association records its opposition to the compulsory adoption of the metric system of weights and measures, which various interests

are asking Congress to legislate for. We do not oppose the metric system as such, but believe that attempts to compel its adoption in the United States unwise, unnecessary, and calculated to disturb seriously the standards of measurement now uniformly used in this industry.

(Abstract from a letter by H. A. Long, secretary, Nov. 4, 1921:)

This association has 9 members at the present time. Our members employ approximately 2,000 men.

The capital invested by our members is approximately $2,000,000.

Our members make approximately 50 per cent of the horse-drawn vehicle wood wheels made in this country, and in normal times make approximately 65 per cent of the total production.

HOT ROLLED STRIP STEEL INSTITUTE,
Pittsburgh, Pa., January 19, 1921.

Attention was called to a bill introduced in the Senate by Senator Frelinghuysen establishing the metric system in the United States, following which the secretary was directed to write a letter to the several Congressmen and to the Senate Committee on Standards, Weights, and Measures, stating that this association as a body vigorously protest the passage of any bill making the metric system a standard in the United States.

(Information contained in a letter from C. M. Best, secretary, Nov. 22, 1921:)

All cold-rolled strip steel is made from hot-rolled strip steel. There are approximately 3 tons of hot-rolled steel made for every 1 ton of cold-rolled steel, so that the membership of this institute represents approximately an annual tonnage of 552,000 net tons.

CHAMBER OF COMMERCE OF THE UNITED STATES,
IRON AND STEEL GROUP,
Atlantic City, N. J., December 4, 1918.

Whereas the advocates of the metric system are endeavoring to make its assumed necessity in foreign trade the basis for its compulsory use in the United States; and

Whereas the investigations of the American Institute of Weights and Measures have clearly proved that our present system is no barrier to trade with so-called metric countries; and

Whereas the British High Commission reported unanimously against the adoption of the metric system for Great Britain; and

Whereas the changing of our system of weights and measures would impose a serious and entirely unnecessary burden on our mechanical industries at this time, giving, many believe, a distinct advantage to German-made goods: Be it

Resolved, That the conference of the war service committees of the Chamber of Commerce of the United States declare it to be unwise to make any change in our system of weights and measures at this time.

INSTITUTE OF COLD ROLLED STRIP STEEL,
New York, N. Y., January 18, 1921.

(Abstract from a letter to the institute:)

It was resolved that the secretary direct a letter to our Senators and Congressmen and to the Senate Committee on Standards, Weights, and Measures, strongly protesting the enactment of any law establishing the metric system in the United States.

INSTITUTE OF COLD ROLLED STRIP STEEL,
C. M. BEST, *Secretary.*

(Abstract from a letter by C. M. Best, secretary, Nov. 22, 1921:)

The number employed in the cold rolled strip steel industry is approximately 25,000 men. The industry also has a capital of upward of $50,000,000. Practically 95 per cent of the machinery employed has been made in the United States. The production of the mills of this association for the year 1920 (a fair

average year) was 184,037 net tons, having a value of $31,463,717.36. The total production of all mills, including nonmember in the industry, was about 434,000 net tons of a total value of upward of $75,000,000. The field of the membership covers the entire United States.

METER MANUFACTURERS' EXCHANGE,
New York, N. Y., November 4, 1920.

That the exchange go on record as opposed to the adoption of the metric system.

MOTOR AND ACCESSORY MANUFACTURERS' ASSOCIATION,
Atlantic City, N. J., April 26, 1920.

Whereas the members of this association have formally registered their opposition to the adoption of the metric system on the grounds that it is uneconomic; that the disadvantages of the metric system are not offset by the advantages; that the benefits of the metric system do not justify the enormous expense which would be entailed through the necessary changes in size of product and equipment (which would mean an excessive loss through destruction of the present equipment not adapted to the new system) and through the education of employees and customers: Therefore be it

Resolved, That this committee express for the members of the Motor and Accessory Manufacturers' Association its opposition to any legislative action which would result in making the adoption of the metric system of weights and measures obligatory; and further be it

Resolved, That this committee recommend to the members of this association the work of the American Institute of Weights and Measures in opposing the compulsory adoption of the metric system.

(Abstract from a letter by M. I. Heminway, general manager, Nov. 5, 1921.)

Membership approximately 400. Employees of members approximately 500,000. Unable to state amount of capital invested by our members, but gross sales approximate a billion and a half to two billion annually. The sales of our members probably run from 70 to 80 per cent of gross sales by all manufacturers of automotive parts and equipment.

We wish to reiterate to you our previous statement that our members are definitely opposed to the adoption of the metric system universally, or in this country, from a practical standpoint.

THE NATIONAL ASSOCIATION OF CORRUGATED FIBRE BOX MANUFACTURERS.
St. Louis, Mo., October 18, 1920.

Whereas the industries of this country have very successfully used the English systems of weights and measures and

Wherea we believe it would be detrimental to the best interests of the country to substitute the metric system of weights and measures for the system that has been so successfully used: Therefore be it

Resolved, That the National Association of Corrugated Fibre Box Manufacturers express its opposition to congressional action to force the metric system of weights and measures upon the industries of this country; and further be it

Resolved, That this association express its commendation of the publicity work engaged in by the American Institute of Weights and Measures in opposition to the efforts being made to force congressional legislation in favor of the metric system of weights and measures.

Abstract from a letter by B. C. Tamlin, secretary and treasurer, Nov. 4, 1921:

"We have 56 active members and 40 associate members. While we cannot tell you with any degrees of accuracy how many employees our members control, we can safely say that it is several thousand. It is our opinion that our association represents at least 50 per cent of the corrugated and solid fiber industry."

NATIONAL ASSOCIATION OF IMPORTERS OF HIDES AND SKINS (INC.),
New York, N. Y., October 6, 1920.

Resolved, That this association is opposed to any steps looking toward a change in the present system of weights and measures at the present time.

NATIONAL ASSOCIATION OF MANUFACTURERS,
New York City, December, 1919.

It is further resolved that we indorse the work of the American Institute of Weights and Measures in opposing the adoption of the metric system.

Abstract from a letter by G. S. Boudinot, secretary, November 4, 1921:

Our membership comprises about 5,500 American manufacturers located in practically every state in the Union and engaged in every line of manufacturing activity.

NATIONAL AUTOMOBILE CHAMBER OF COMMERCE (INC.),
New York, N. Y., March 3, 1920.

Whereas efforts are being made to require by congressional legislation the use of the metric system of weights and measures in this country; and

Whereas a canvass of motor-car manufacturers, members of this organization, has failed to develop that any of them are in favor of such legislation, owing particularly to the difficulty at this time of changing dies, factory equipment, and mechanism, and the great cost of same; also the confusion that would be created among workmen who have not been educated in the metric system: Be it

Resolved, That this board is opposed to legislation making the use of the metric system of weights and measures obligatory, and recommends that members of the National Automobile Chamber of Commerce lend their support to the American Institute of Weights and Measures, which is actively opposing this movement.

(Abstract from a letter by J. S. Marvin, assistant general manager, Nov. 4, 1921:)

The membership of this association numbers 131 manufacturers of automobiles and trucks.

Capital invested in the motor vehicle manufacturing business in 1920 was $1,204,378,642, including members and nonmembers.

The membership covers the manufacturing field very broadly, except that the Ford Motor Co. is not a member.

We are very glad to note you are arranging to present data to the Senate subcommittee, as our organization is opposed to the compulsory adoption of the metric system.

NATIONAL AUTOMOBILE DEALERS' ASSOCIATION,
Chicago, Ill., September 9, 1920.

At a meeting of the board of directors of the National Automobile Dealers' Association, held at the La Salle Hotel, Chicago, Ill., on September 9, 1920, the board declared itself as being opposed to the compulsory use of the metric system.

NATIONAL BRICK MANUFACTURERS' ASSOCIATION,
New York, N. Y., February 4, 1921.

Whereas an active propaganda is being conducted for the compulsory adoption of the metric system of weight and measure; and

Whereas bills are now pending before the Senate and House of Representatives providing for compulsory adoption and forcible substitution of metric units in place of our established system; and

Whereas we believe that such a radical change would be hostile to the business and industrial interests of this country, entailing enormous cost and confusion without compensating advantages: Therefore be it

Resolved, That the National Brick Manufacturers' Association place itself on record as being opposed to the compulsory adoption of the metric system, and

that it commends the work of the American Institute of Weights and Measures in opposition to such adoption.

(Abstract from a letter by T. A. Randall, secretary, Nov. 5, 1921:)

Our membership comprises the representative men in the brick and tile industries, the total number of employees will probably aggregate 10,000, and there are ten times that many engaged in the industry for whom our membership speaks in a measure.

The total capital invested by our members will aggregate a half billion dollars. Our membership covers about 10 per cent of those engaged in clay working throughout this country.

THE NATIONAL HAY ASSOCIATION,
Winchester, Ind., September 11, 1920.

Whereas efforts are being made to require by congressional legislation the use of the metric system of weights and measures in this country; and

Whereas the industries of the Nation have been built up and are administered on the basis of the English system of weights and measures; and

Whereas the encouragement of compulsory adoption of the metric system means the creating of a lack of uniformity of weights and measures in industry and elsewhere in place of the substantial uniformity now enjoyed in this country: Therefore be it

Resolved, That the National Hay Association is opposed to legislation compelling the use of the metric system of weights and measures and recommends that no change whatever be made by the Congress of the United States or any other official body; and be it further

Resolved, That the members of this association cooperate with the American Institute of Weights and Measures, New York, N. Y., in opposing the compulsory adoption of the metric system.

NATIONAL IMPLEMENT AND VEHICLE ASSOCIATION,
Chicago, Ill., October 12, 1921.

Resolved, That the disorganization of industry which would result from the changing of our machines and measurements to conform to the metric system would be infinitely greater than the advantages to be secured therefrom, and that we are unalterably opposed to the establishment of such a system in this country.

(Abstract from a letter by H. J. Sameit, secretary, Nov. 23, 1921:)

The name of this association was changed on October 14, 1921, to the "National Association of Farm Equipment Manufacturers."

Our membership consists of 313 active members and 213 associate members. Our active members are engaged in the manufacture of farm equipment, and our associate members are those who are in a position to provide our active members with the material, equipment, or service required by them.

The total number of employees in this industry, according to a recent compilation, is approximately 114,000 during normal times, and of this number 102,000 are in the employ of our active members.

The membership of this industry (active members) represents about 95 per cent of the total production of farm equipment in the United States.

THE NATIONAL INDUSTRIAL TRAFFIC LEAGUE,
Louisville, Ky., October 1, 1920.

Whereas the metric system has been legal in the United States since 1866 and may be used by those who desire to do so; and

Whereas the compulsory adoption would incur an expense of hundreds of millions of dollars upon the manufacturers in changing their plant facilities; and

Whereas it would necessitate the railroads changing all their scales, republishing all their tariffs, both freight and passenger; in fact, a most revolutionary step: Therefore be it

Resolved, That the National Industrial Traffic League place itself on record as being opposed to the compulsory use of the metric system; be it further

Resolved, That the executive secretary be directed to keep in touch with the subject and oppose its adoption if the matter is brought up in Congress.

(Abstracts from a letter by J. H. Beck, executive secretary, Nov. 5, 1921.)

The membership of the National Industrial Traffic League is comprised of chambers of commerce, boards of trade and commercial organizations, as well as industrial concerns. Our total membership is 1,029. However, a single membership held by a chamber of commerce, for example, represents in many instances several thousand representative shipping concerns. Take, for example, the Chicago Association of Commerce. It holds but one membership in the leagut, but it in turn has a membership of from 6,000 to 7,000.

There are included in our membership the more important chambers of commerce and commercial organizations, as well as the larger industrial concerns throughout the United States.

NATIONAL LEAGUE OF COMMISSION MERCHANTS
OF THE UNITED STATES,
St. Louis, Mo., January 24, 1921.

At the annual convention of this organization held in the city of St. Louis on January 12 and 14 the matter was considered as part of the report of our special committee on weights and measures, following which a resolution was unanimously passed that the National League of Commission Merchants of the United States is opposed to the substitution of the metric system of weights and measures for the present system.

H. S. FRENCH,
General Manager and Secretary.

(Abstract from a letter by R. S. French, general manager, Nov. 23, 1921:)

The attitude of this organization with respect to this bill is no different to-day than when I wrote you on January 24, following our convention, at which time this subject was considered and a resolution unanimously passed that this organization is opposed to the substitution of the metric system of weights and measures for the present system.

We have 635 members. Their activities cover practically the entire United States from the Pacific to the Gulf coast and Atlantic seaboard, as we are located in 31 States and 100 cities. It is conservatively estimated that our members handle and ship from and to points in the United States and abroad approximately 500,000 carloads of fruits and vegetables annually.

NATIONAL METAL TRADES ASSOCIATION,
New York, N. Y., April —, 1920.

Whereas the industries of the Nation have been built up and are administered on the basis of the English system of weights and measures; and

Whereas there has been a great activity in behalf of the so-called metric system of weights and measures to secure the enactment of compulsory legislation by the Government, which activity is generally fostered by the World Trade Club of San Francisco, and which propaganda is financed by large sums of money of unknown amount and unknown origin; and

Whereas this propaganda is made up of half truths, deliberate falsehoods, and extravagant claims which can not be substantiated by the facts of trade or commerce; and

Whereas the encouragement of compulsory adoption of the metric system means the creation of a lack of uniformity of weights and measures in industry and elsewhere in place of the substantial uniformity now enjoyed in this country; be it

Resolved, That the National Metal Trades Association reaffirms its action of previous years in unalterably opposing governmental encouragement of the metric system in our industrial life and any legislation proposing to compel the use of such metric system.

(Abstract from a letter by H. D. Sayre, secretary, Nov. 28, 1921:)

Membership approximately 1,000. Number of employees controlled by our membership in normal times about 500,000.

NATIONAL RETAIL LUMBER DEALERS' ASSOCIATION,
Chicago, Ill., October 22, 1920.

Absolutely and positively opposed to the proposed metric system, and is in favor of our present system of weights and measures.

(Abstract from a letter by A. Pfund, secretary-manager, Nov. 26, 1921:)

We beg to advise that this organization more than a year ago went on record emphatically as opposed to the plan of compulsory adoption of the metric system in this country. We are just as emphatically opposed to that measure now, and therefore also to Senate bill 2267, and desire to register our protest against its passage.

Our organization, while young, represents almost a thousand retail lumber yards located in the larger centers of population throughout the country. This membership represents a capital investment of close to $200,000,000 and employeees numbering over 50,000, to the best of our information.

PHOTOGRAPHERS' ASSOCIATION OF AMERICA,
Cleveland, Ohio, August 26, 1920.

Whereas the members of the Photographers' Association of America, in annual convention assembled, have heard the arguments in opposition to any change in the present form of our standard weights and measures; and

Whereas it is universally conceded that any change to any other system would work a great inconvenience in a business such as photography where weights and measures are a part of the daily routine: Therefore, be it

Resolved, That this association go on record as opposing any action, legislative or otherwise, as would bring about any change in our present form of standard weights and measures; and further be it resolved that the activities of the American Institute of Weights and Measures on behalf of the present standard weights and measures be highly commended.

(Abstract from a letter by J. C. Abel, general secretary, Nov. 4, 1921:)

The total membership at this date is 1,800.

In addition affiliated to and chartered by this organization are eight amalgamated State organizations, each containing from 300 to 550 members. The membership is country wide.

Taking into account the membership of this organization and the chartered affiliated bodies, about two-fifths of all the photographers of the country are connected with this body and therefore stand back of our support of our present forms of weights and measures and consequently against any change to the metric system.

The capital invested by our own and affiliated members will be in the neighborhood of $20,000,000,—while the capital invested by our associate members, the manufacturers and dealers will run to about $125,000,000.

RANGE BOILER EXCHANGE,
New York, N. Y., Sept. 7, 1921.

Unanimously resolved that the Range Boiler Exchange go on record as being opposed to the compulsory adoption of the metric system.

(Abstract from a letter by A. A. Ainsworth, secretary, Nov. 7, 1921:)

The Range Boiler Exchange is a small association and covers about 50 per cent of the output of the commodity.

RUBBER ASSOCIATION OF AMERICA,
January 18, 1921.

Attention was directed in the docket to a metric standards bill introduced in Congress providing for the gradual substitution of the metric system of weights and measures as the exclusive standard in the United States after a transition period of 10 years.

After discussion, the board formally adopted a motion to the effect that the general manager be requested to prepare a resolution which will express the disapproval of the board of the proposed legislation.

THE RUBBER ASSOCIATION OF AMERICA,
TIRE MANUFACTURERS' DIVISION,
May 6, 1920.

Resolved, That the tire manufacturers' division is opposed to the compulsory adoption by law of the metric system as the standard measurement system in the United States; and it is further

Resolved, That as manufacturers of a product which finds a market in European countries, the tire manufacturers' division recognizes the necessity for meeting conditions existing in those countries with respect to the metric marking of tires in addition to the marking of the American inch size; and it is further

Resolved, That inasmuch as Mr. E. H. Huxley, president United States Rubber Export Co. (Ltd.), is to attend the National Foreign Trade Convention, he be asked to present this resolution to that convention on behalf of the tire manufacturers' division of the rubber association.

STEEL BARREL MANUFACTURERS' ASSOCIATION,
New York, N. Y., August 3, 1920.

This association is in sympathy with the efforts of the American Institute of Weights and Measures to maintain our present system of weights and measures.

THE SOCIETY OF AUTOMOTIVE ENGINEERS (INC.),
Ottawa Beach, Mich., June 22, 1920.

Whereas it has been represented to the public through the press and by other means that it would be desirable to have the metric system of weights and measures made compulsory in usage in the United States; and

Whereas it is the sense of the Society of Automotive Engineers (Inc.), assembled in business session, that such action would subject the country to curtailment of production and to economic loss: Therefore be it hereby

Resolved, That the compulsory enforcing of the metric system of weights and measures as the legal standard of measurement is opposed by this society as economically unsound and inimical to the best interests of the country.

(Abstract from a letter by C. D. Le Fevre, section secretary, Nov. 22, 1921:)

The society is composed of about 5,000 engineers and executives connected with the automotive industry, i. e., automobile, truck, tractor, aircraft, motor boat, etc.

The object of the society is to promote the arts and sciences and standards and engineering practices connected with the design and construction of automobiles, all forms of self-propelled or mechanically-propelled mediums for the transportation of passengers or freight, and internal-combustion prime movers.

AMERICAN ERECTORS' ASSOCIATION,
Pittsburgh, Pa., November 11, 1921.

Whereas the establishment of the metric system in the United States as a single standard of weights and measures would result in enormous expense and confusion to industry and to the public in general, wihout adequate benefits: Therefore be it

Resolved, That the American Erectors' Association is opposed to the compulsory use of the metric system as a single standard of weights and measures in the United States.

(Abstract from a letter by H. R. Brady, commissioner, Nov. 17, 1921:)

The American Erectors' Association is composed of 17 concerns engaged in the fabrication and erecting of iron storage tanks and refinery equipment.

STATE ASSOCIATIONS.

California White & Sugar Pine Manufacturers' Association.
Colorado Manufacturers' & Merchants' Association.

Hawaiian Manufacturers' Association.
Kentucky Manufacturers' Association.
Associated Industries of Massachusetts.
Michigan Implement Dealers' Association.
Michigan Manufacturers' Association.
New Hampshire Manufacturers' Association.
New Jersey Lumbermen's Association.
Drill & Reamer Society in New York.
New York State Association of Builders.
Retail Lumber Dealers' Association of New York.
Ohio Manufacturers' Association.
American Association of Engineers, Oklahoma.
Oregon Retail Jewelers' Association.
Rhode Island Textile Association.
Rotary Club of Greater Wilkes-Barre, Pa.
Pennsylvania Trade Secretaries.

CALIFORNIA WHITE & SUGAR PINE MANUFACTURERS' ASSOCIATION,
San Francisco, Calif., October 16, 1920.

At a regular meeting of the board of directors of the California White & Sugar Pine Manufacturers' Association a resolution was presented against any change in present weights and measures. Upon motion, duly seconded and unanimously carried, the secretary-manager was directed to inform the American Institute of Weights and Measures that this association is strongly opposed to making any change in present standard weights and measures.

(Abstract from a letter by C. S. Smith, secretary-manager, Nov. 21, 1921:)
Membership, 45 pine manufacturers in California pine region, which includes the State of California and Klamath and Lake Counties, Oreg.; number of employees controlled by membership, 12,000; capital invested, $80,000,000; 95 per cent of pine lumber produced in this region represented in association membership. List of members inclosed.

THE COLORADO MANUFACTURERS' AND MERCHANTS' ASSOCIATION,
Denver, Colo., June 12, 1920.

Whereas there has been called to the attention of the Colorado Manufacturers' and Merchants' Association the aggressive campaign being waged in favor of the adoption in this country of the metric system of weights and measures; and

Whereas the result of the adotion of the metric system will cause confusion in American commerce and industry: Therefore be it

Resolved, That the Colorado Manufacturers' and Merchants' Association disapprove the adoption in this country of the metric system of weights and measures.

(Abstract from a letter by W. J. Doran, president, Nov. 26, 1921:)
We wish to state that, in accordance with the resolution passed by the board of directors of this association now on file with you, you have our full cooperation in opposing the passage of the bill.
Membership, 391 members, with 300 auxiliary members; number of employees our membership controls, 15,000; capital invested by our members, $50,000,000; per cent of particular field covered by our membership, 50 per cent of State.

HAWAIIAN SUGAR PLANTERS' ASSOCIATION,
Honolulu, Hawaii, September 17, 1920.

This association is opposed to any change being made in the American standard of weights and measures.

KENTUCKY MANUFACTURERS' ASSOCIATION,
June 4, 1920.

The directors expressed unanimous disapproval of the measure now pending in Congress which provides for the adoption of the metric system standard of

measures in the United States. The motion carried with it instructions that the resolution be placed in the hands of the chairman and members of the Committee on Coinage, Weights, and Measures in the House.

THE ASSOCIATED INDUSTRIES OF MASSACHUSETTS,
February 10, 1919.

Voted unanimously that the Associated Industries of Massachusetts record its opposition to the adoption of the metric system by the United States of America.

(Abstract from a letter by O. L. Stone, general manager, Nov. 22, 1921:)

The membership of the Associated Industries of Massachusetts is made up of some 1,550 manufacturing concerns doing business in the Commonwealth of Massachusetts, and includes a relatively small number of corporations, partnerships, and individuals whose interests are collateral to manufacturers.

The 1,550 concerns doing business in this State that are affiliated with the Associated Industries of Massachusetts employ in normal times approximately 500,000 men and women.

The capital invested in the plants represented in the membership of the Associated Industries of Massachusetts is approximately $2,000,000,000.

The percentage of the field covered by our membership is approximately 70 to 75 per cent of the going industrial concerns located in the State of Massachusetts.

MICHIGAN IMPLEMENT DEALERS' ASSOCIATION,
August 17, 1920.

Whereas certain interests are using their best efforts to have passed by Congress a compulsory metric system of weights and measures, and as this would cause endless amount of confusion and expense we, the directors of the Michigan Implement Dealers' Association assembled, are opposed to any change of our present system of weights and measures.

MICHIGAN MANUFACTURERS' ASSOCIATION,
——— ——, *1920.*

That the Michigan Manufacturers' Association is opposed to the adoption of the metric system.

(Abstract from a letter by J. L. Lovett, general manager, Nov. 22, 1921:)

The membership of the Michigan Manufacturers' Association is approximately 1,200. Our membership controls approximately 500,000 employees; capital invested is approximately $1,500,000,000. The members of our association represent between 90 and 95 per cent of the capital invested, the products manufactured, and the number of employees.

NEW HAMPSHIRE MANUFACTURERS' ASSOCIATION,
Manchester, N. H., February 3, 1921.

Resolved, That the New Hampshire Manufacturers' Association in convention assembled this 3d day of February, 1921, hereby directs the president and secretary of this association to write to the Senators and Representatives protesting against the passage of this or any measures compelling the use of the metric system.

(Abstract from a letter by Frank A. French, general manager, Nov. 4, 1921:)

We can say that at the present time our membership is 344 and includes approximately 90 per cent of the labor pay roll of the whole State. The majority of the large manufacturing plants are members of our association.

DRILL AND REAMER SOCIETY IN NEW YORK,
New York, N. Y., March —, 1920.

Resolved, That we are unalterably opposed to legislation intended to promote the compulsory adoption of the metric system in this country.

NEW YORK STATE ASSOCIATION OF BUILDERS,
New York City, N. Y., October 25, 1920.

At a meeting of the executive committee of the New York State Association of Builders, held in the city of New York on Monday, October 25, 1920, the following resolution was unanimously adopted:

The New York State Association of Builders is opposed to any change in the existing system of weights and measures and approves the efforts of the American Institute of Weights and Measures to defeat such propositions as have been advanced looking toward the introduction of the metric system.

(Abstract from a letter by E. A. Keeler, secretary-treasurer, Nov. 5, 1921:)

With regard to membership, you are informed that the membership of this association is approximately 2,000.

It is impossible to inform you as to the number of employees our membership controls, but it is safe to assume that it is approximately 100,000 employees.

The capital invested by our members amounts to approximately $10,000,000.

RETAIL LUMBER DEALERS' ASSOCIATION OF NEW YORK,
Utica, N. Y., October 5, 1920.

Opposed to the compulsory establishment of the metric system of weights and measures. In case this question becomes serious you may call upon us to support the position you have taken.

(Abstract from a letter by Paul S. Callier, secretary, Nov. 4, 1921:)

Membership, 570. We cover the territory of New York and Massachusetts. About 75 per cent of the firms eligible to membership are affiliated with this organization. We wish you success in placing this matter before Congress.

THE OHIO MANUFACTURERS' ASSOCIATION,
May 18, 1920.

Voted unanimously that the association do nothing to encourage the movement for the adoption of the metric system.

AMERICAN ASSOCIATION OF ENGINEERS,
Oklahoma, August 7, 1920.

The chapter is against the adoption of the metric system in this country at this time on account of the enormous expense and confusion incident thereto.

OREGON RETAIL JEWELERS' ASSOCIATION,
Albany, Oreg., September 1, 1920.

The executive board of the Oregon Retail Jewelers' Association wish to go on record as being opposed to any change in the American standard of weights and measures as are now in use. We consider it unwise to enact any laws that will cause business men of the country any unnecessary work or inconvenience at the present time.

RHODE ISLAND TEXTILE ASSOCIATION,
Providence, R. I., December 20, 1920.

Resolved by the Rhode Island Textile Association, through its executive committee, That we favor the maintenance and standardization of our present system of weights and measures in general use, and express our opposition to proposed legislation making compulsory and exclusive the use of the metric system. Furthermore, that we indorse the work of the American Institute of Weights and Measures.

(Abstract from a letter by E. F. Walker, secretary, Nov. 4, 1921:)

Our association represents more than 100 of the largest mills in Rhode Island in all branches of the textile industry.

They employ approximately 55,000 hands, and represent 75 per cent of the textile industry in the States.

The capital invested by our members represents many millions of dollars.

ROTARY CLUB OF GREATER WILKES-BARRE,
Wilkes-Barre, Pa., June 1, 1920.

At a meeting of the Rotary Club of Wilkes-Barre, on June 1, 1920, the public-affairs committee, which had been studying a resolution as to the adoption of the metric system, brought in an unfavorable report, and upon motion, which was duly seconded and carried, the report of the committee was adopted.

PENNSYLVANIA TRADE SECRETARIES,
Philadelphia, Pa., April 1, 1921.

At a meeting assembled on April 1 at the Manufacturers' Club of the Pennsylvania Trade Secretaries, motion was made and passed on the floor absolutely opposing the installation of the metric system in the United States.

NEW JERSEY LUMBERMEN'S ASSOCIATION,
Newark, N. J., September 14, 1920.

Resolved, That the New Jersey Lumbermen's Association is decidedly and unanimously opposed to the adoption of the metric system. It is felt that the adoption of this system would result in endless confusion and great expense, and there is no necessity for a change in our system of weights and measures.

(Abstract from a letter by J. G. Whittier, secretary, Nov. 7, 1921:)

Our membership is 200. The number of employees our membership controls is from 5 to 150 per member. Capital invested by our members is from $50,000 to $1,000,000, the average yard probably having about $60,000 to $75,000 invested. The percentage of the field covered by our membership is 50 per cent of the total, but it represents the sentiment of the whole industry.

DISTRICT ASSOCIATIONS.

Canadian Manufacturers' Association.
Industrial Association of the Lower Naugatuck Valley.
Manufacturers' Association of Lackawanna County.
Paper Wire Manufacturers' Industrial Council.
Southern Metal Trades Association.
Southern Supply & Machine Dealers' Association.
Southern Sash, Door & Millwork Manufacturers' Association.
Manufacturers' Association of Monroe County.

CANADIAN MANUFACTURERS' ASSOCIATION,
Vancouver, June 9, 1920.

Resolved, That the Canadian Manufacturers' Association in annual meeting assembled in Toronto, on June 12, 1919, indorse the following resolution which was passed by the National Association of Manufacturers of the United States at their annual meeting held on May 20, 1919, in New York:

Whereas national legislation is proposed and is being vigorously urged to substitute the metric system for our present standards of weights and measures; and

Whereas, in the language of the British committee on commercial and industrial policy after the war, which exhaustively investigated this proposal, we are not convinced that the metric system is, upon the whole, even theoretically superior to the British system, and we are satisfied that the practical objections to the proposed change are such as to decisively outweigh any advantages which are claimed for it: Therefore be it

Resolved, That we regard the present period of difficult readjustment from war to peace as a most untimely period in which to discuss or adopt a new

system of weights and measures and thus add another to the many trying difficulties of this hour.

(Abstract from a letter by J. T. Stirett, general secretary, Nov. 4, 1921:)
The Canadian Manufacturers' Association represents about 90 per cent of the manufacturing done in Canada. The Canadian Government in January, 1921, stated the value of products for the year 1918 to be $3,458,036,975. Our membership is about 4,300, located in all the Provinces of Canada.

THE INDUSTRIAL ASSOCIATION OF THE LOWER NAUGATUCK VALLEY,
Derby, Conn., December 31, 1920.

Moved that we consider any efforts made to render the metric system compulsory by legislation particularly unfortunate and that same should be opposed in every legal manner. Voted.

(Abstract from a letter by P. L. Gerety, secretary, Nov. 23, 1921:)
Membership, 80; number of employees your membership controls, normally about 12,000; capital invested by your members, about $40,000,000; per cent of particular field covered by your membership, 90 per cent.

MANUFACTURERS' ASSOCIATION OF LACKAWANNA COUNTY,
Scranton, Pa., April 20, 1920.

This association in meeting assembled on April 20, 1920, voted unanimously opposing the adoption of the metric system.

(Abstract from a letter by E. W. Osborne, secretary, Nov. 14, 1921:)
The Manufacturers' Association of Lackawanna County has a membership of 100, employing more than 13,000 people, with an invested capital of approximately $10,000,000, and comprises approximately 70 per cent of the leading manufacturers throughout Lackawanna County.

THE MANUFACTURERS' ASSOCIATION OF MONROE COUNTY,
Stroudsburg, Pa., December —, 1921.

At a meeting of the Manufacturers' Association of Monroe County Senate bill 2267, which fixes the metric system as a single standard of weights and measures in the United States, was brought to the attention of the asssociation, and the association went on record as being opposed to the compulsory adoption of the metric system.

We therefore urge you to oppose this bill and also use your influence in having it defeated.

B. L. SMALL, *Secretary.*

PAPER WIRE MANUFACTURERS' INDUSTRIAL COUNCIL,
Chicago, Ill., May 2, 1921.

At a meeting of the Paper Machine Wire Manufacturers' Industrial Council (comprising nine manufacturers of Fourdrinier wires) held on May 2 a resolution was passed unanimously recording the following-named companies as opposed to the adoption of the metric system as a substitute for that now in general use: Appleston Wire Works; Buchanan & Bolt Wire Co.; The William Cabble Excelsior Wire Manufacturing Co.; Cheney Bigelow Wire Works; Eastwood Wire Manufacturing Co.; The Lindsay Wire Weaving Co.; Joseph O'Neill Wire Works; The W. S. Tyler Co.; Wisconsin Wire Works.

Will you kindly therefore register the opposition of the paper Machine Wire Manufacturers' Industrial Council represented by the Armstrong Bureau of Related Industries.

(Abstract from a letter by C. Rosenfels, November 26, 1921:)
Membership, 9; number of persons employed by our members, 1,704; capital invested, approximately $10,000; field covered, 98 per cent.

SOUTHERN METAL TRADES ASSOCIATION,
Norfolk, Va., August 26, 1920.

Resolved, That the North Carolina division of the Southern Metal Trades Association hereby declares its opposition to any legislation having for its purpose the adoption of the metric system in the United States as the exclusive legal standard of weights and measures.

Resolved further, That we commend the work of the American Institute of Weights and Measures in opposition to the compulsory adoption of the metric system.

(Abstract from a letter by W. E. Dunn, jr., secretary, Nov. 7, 1921:)

This association has a membership of 140 iron and steel industries of the South, scattered from Virginia to Texas, representing invested capital of over $50,000,000, which industries employ more than 25,000 workers.

SOUTHERN SUPPLY AND MACHINERY DEALERS' ASSOCIATION,
Atlantic City, N. J., ——— ——, 1920.

Whereas a bill has been introduced in the Senate of the United States to adopt the weights and measures of the metric system as the standard weights and measures in the United States: In view of this effort be it

Resolved, That it is the opinion of the Southern Supply and Machinery Dealers, in convention assembled, that the adoption of the metric system would seriously interfere with long-established methods of doing business, and that without any degree of benefit, and we therefore desire to go on record as being opposed to any change from the present standards.

(Abstract from a letter by A. M. Smith, secretary and treasurer, Nov. 4, 1921:)

We have the pleasure of advising you that our membership is composed of 153 firms, stretching from Baltimore to El Paso. The average number of employees is 30 to the firm, or about 4,500. Our membership covers the entire South and Southwest.

Please do not forget that we have gone on record repeatedly as opposing any change in our system of weights and measures, and our members have been instructed and requested to urge their Senators and Representatives in Congress to vote against any bill offered in either the Senate or the House for a change from the present system.

SOUTHERN SASH, DOOR AND MILLWORK MANUFACTURERS' ASSOCIATION,
Atlanta, Ga., November 18, 1920.

At our annual meeting it was resolved that we go on record as being opposed to any change in the American standard of weights and measures, and that the American Institute of Weights and Measures, 115 Broadway, be advised of our action.

(Abstract from a letter by C. B. Harman, secretary and treasurer, Nov. 5, 1921:)

Our membership is 115; our membership employs 5,750 men; capital invested, $6.000,000; per cent of field, 75 per cent.

CHAMBERS OF COMMERCE.

American Chamber of Commerce in France.
Buffalo Chamber of Commerce.
Cleveland Chamber of Commerce.
Flint (Mich.) Board of Commerce.
Great Wilkes-Barre (Pa.) Chamber of Commerce.
Johnstown (Pa.) Chamber of Commerce.
Hartford Chamber of Commerce.
Hoboken (N. J.) Chamber of Commerce.
Moline (Ill.) Commercial Club.
New Britain Chamber of Commerce.
Newburgh (N. Y.) Chamber of Commerce.
Pennsylvania State Chamber of Commerce.

Pittsburgh Chamber of Commerce.
Providence Chamber of Commerce.
Rochester (N. Y.) Chamber of Commerce.
Springfield (Mass.) Chamber of Commerce.
Springfield (Ohio) Chamber of Commerce.
St. Louis Chamber of Commerce.
Syracuse (N. Y.) Chamber of Commerce.
Trenton Chamber of Commerce.
Waterbury (Conn.) Chamber of Commerce.
York (Pa.) Chamber of Commerce.

AMERICAN CHAMBER OF COMMERCE IN FRANCE,
Paris, France, March 2, 1921.

Resolved, That the American Chamber of Commerce in France, while generally favoring the extension and gradual application of the metric system of weights and measures, is unalterably opposed to any compulsory act requiring the exclusive use thereof in the United States.

BUFFALO CHAMBER OF COMMERCE,
Buffalo, N. Y., October 12, 1920.

Unanimously opposed to the adoption of the metric system and in favor of retaining the present standards of weights and measures.

(Abstract from a letter by George C. Lehmann, general secretary, Nov. 4, 1921:)

The membership of the Buffalo Chamber of Commerce at present is slightly in excess of 3,000 and includes practically every large industry in this city.

It may be of interest in this connection to know that Buffalo probably has the greatest diversity of industries of any city in the country, with the possible exception of New York. Yet we have failed to uncover a single concern that favors the metric system.

CLEVELAND CHAMBER OF COMMERCE,
June 16, 1920.

Your committee, after consideration of its investigation and of the facts that have come to its attention, earnestly urges the chamber of commerce to go on record as being absolutely opposed to the compulsory adoption of the metric system of weights and measures in this country, and strongly recommends that the chamber of commerce direct communications to the members of the Committee on Coinage, Weights, and Measures of the Congress of the United States and to all of the representatives of Ohio in the Congress of the United States opposing a legislation which will, in our opinion, be so disastrous to all of us.

(Abstract from a letter by C. Gildersleeve, industrial commissioner, Nov. 5, 1921:)

The Cleveland Chamber of Commerce has more than 4,000 members.

It is, perhaps, sufficient to say that the members of this organization, broadly speaking, represent practically every institution of any considerable size in Cleveland and vicinity.

FLINT (MICH.) CHAMBER OF COMMERCE,
Flint, Mich., July 1, 1920.

The industrial department records its unanimous opposition to the voluntary adoption of the metric system and recommends that its entire membership as a body go on record in disapproval of the voluntary adoption of the metric system.

(Abstract from a letter by W. F. Hufstader, publicity manager, Nov. 10, 1921:)

Membership is 2,250; capital invested by members, $56,250; membership controls approximately 25,000 employees in Flint.

The chamber of commerce can be said to cover practically the entire city, for we have chamber of commerce memberships in proportion to a city of 250,000 tion, and the population of Flint is 105,000.

GREAT WILKES-BARRE (PA.) CHAMBER OF COMMERCE,
March 16, 1920.

Your committee unanimously advises against the recommendation of the adoption of the meter-litergram system by the Rotary Club and Chamber of Commerce of Wilkes-Barre.

JOHNSTOWN (PA.) CHAMBER OF COMMERCE, INC.,
July 22, 1920.

The chamber of commerce has gone on record as being opposed to the adoption of the metric system at this time.

HARTFORD CHAMBER OF COMMERCE,
Hartford, Conn., March 31, 1920.

The directors went on record as being opposed to any change in the American standard of weights and measures and against the propaganda being spread throughout the country for the adoption of the metric system.

(Abstract from a letter by W. L. Mead, secretary, Nov. 4, 1921:)

Membership, 1,000; number of employees our membership controls, 40,000; capital invested by our members, $250,000,000; per cent of particular field covered by our membership is 95 per cent.

HOBOKEN (N. J.) CHAMBER OF COMMERCE,
———— ——, *1920.*

The board of directors voted to oppose the proposed plan to adopt the metric system on the ground that at this time any change would be unwise, and in addition it is seriously questioned that the proposed system would offer any advantage.

MOLINE (ILL.) COMMERCIAL CLUB,
July 19, 1920.

On record as being opposed to the compulsory adoption of the metric system.

NEW BRITAIN (CONN.) CHAMBER OF COMMERCE,
March 15, 1920.

Whereas national legislation is proposed and is being vigorously urged to make the use of the metric system of weights and measures compulsory, as well as compel the disuse of the English system of the foot, inch, pound, ounce, etc.; and

Whereas a bill to this effect has been proposed for presentation to this Congress; and

Whereas such a change can only be accomplished at great cost, after much confusion, and with no compensating benefits; and

Whereas such a change, we believe, would be inimical and detrimental to industry generally: Therefore be it

Resolved, That the New Britain Chamber of Commerce, representative of and expressing the desires of the manufacturers of New Britain, does hereby condemn and oppose all legislation toward bringing about a compulsory change in the system of weights and measures now in general and satisfactory use.

NEWBURGH (N. Y.) CHAMBER OF COMMERCE,
April 13, 1920.

This question has been discussed by the officers and directors of our chamber of commerce, and the secretary has been directed to inform you that our association is decidedly opposed to the adoption of the metric system, on account of the endless confusion and great expense that will be caused by making the change, and also on account of the lack of necessity for so doing.

PENNSYLVANIA STATE CHAMBER OF COMMERCE,
Harrisburg, Pa., April 7, 1920.

Action was taken "opposing any compulsory adoption of the metric system."

(Abstract from a letter by George E. Foss, general secretary, Nov. 5, 1921:)
In organization and individual memberships we represent over 40,000 of the leading business men in the State of Pennsylvania.

The number of employees that our members have would doubtless reach into the hundred thousands, since we have as members many of the largest corporations in the State of Pennsylvania.

The capital invested by members of this organization would reach many millions.

Our membership is not confined to any particular field. It is true that we have more manufacturers than any other line of business, but we have probably every line of business in the State represented in our membership.

PITTSBURGH CHAMBER OF COMMERCE,
Pittsburgh, Pa., February, 1920.

Resolved, That the Chamber of Commerce of Pittsburgh unqualifiedly condemns all efforts to effect any change in the existing system of weights and measures as impractical and inimical to the trade and general commercial interests of our country.

(Abstract from a letter by A. C. Terry, secretary, Nov. 8, 1921:)
The Chamber of Commerce of Pittsburgh membership is in excess of 5,500 active members. The number of employees controlled by members of the chamber of commerce will approximate 600,000 in the Pittsburgh district alone. The amount of capital represented by them is way up in the millions and possibly a few billions. Practically all manufacturing fields, also coal, oil, food products, merchandise of all descriptions, etc., are represented in our membership.

PROVIDENCE (R. I.) CHAMBER OF COMMERCE,
Providence, R. I., November 23, 1920.

Abstract from a letter:
"I am advising that the board of directors of the Providence Chamber of Commerce, acting on the recommendation and advice of our committee on industrial development, have gone on record as opposed to the compulsory adoption of the metric system of weights and measures.

"CLARENCE A. COTTON,
"*General Secretary.*"

ROCHESTER CHAMBER OF COMMERCE,
Rochester, N. Y., May 3, 1920.

The managers' group of the industrial management council records its unanimous opposition to the compulsory adoption of the metric system, and furthermore recommends to the officers of the Rochester Chamber of Commerce that they, as a body, go on record in disapproval of the compulsory adoption of the metric system.

(Abstract from a letter by Eliott Frost, director, Nov. 5, 1921:)
The Rochester Chamber of Commerce has approximately 4,200 members, which includes manufacturers and all trade and professional interests.

Probably our membership controls at least 80,000 employees, representing a capital stock of about $150,000,000.

SPRINGFIELD CHAMBER OF COMMERCE,
Springfield, Mass., June 14, 1921.

Resolved, That the board of directors go on record in opposition to the establishment of the metric system and the Senators and Congressmen at Washington from this State be so advised.

(Abstract from a letter by B. A. Hapgood, associate secretary, Nov. 9, 1921:)
Membership, 2,000. Our chamber, through its membership, reaches our entire community and is directly identified with all of our interests. We are espe-

cially fortunate in having identity with the large manufacturing interests, who are strongly opposed to the forceful adoption of the metric system.

SPRINGFIELD (OHIO) CHAMBER OF COMMERCE,
August 9, 1920.

Be it resolved, That the board of directors of the Springfield Chamber of Commerce are opposed to the adoption of the metric system taking place of the present standard of weights and measures.

ST. LOUIS CHAMBER OF COMMERCE,
St. Louis, Mo., ——— ——, *1920.*

The St. Louis Chamber of Commerce is opposed to legislation making compulsory the use of the metric system of weights and measures in the United States as inimical to the commercial and industrial interests of the country.

(Abstract from a letter by R. D. Sangster, industrial commissioner, Nov. 8, 1921:)

The membership of the chamber is 4,500.

Over 200,000 male and female employees are in the service of individual firms and corporations members of this chamber.

Over 90 per cent of the total business in manufacturing, wholesale, retail, and jobbing lines is done by individuals, firms, and corporation members of the chamber of commerce.

SYRACUSE (N. Y.) CHAMBER OF COMMERCE,
August 9, 1920.

Be it Resolved, That the Syracuse Chamber of Commerce is unanimously opposed to legislation intended to promote the compulsory adoption of the metric system of weights and measures in this country.

TRENTON (N. J.) CHAMBER OF COMMERCE,
April 1, 1920,

Voted that the adoption of the metric system is opposed for this country.

WATERBURY (CONN.) CHAMBER OF COMMERCE.

On record as opposing the metric system of weights and measures and as favoring the retention of the present system.

(Abstract from a letter by T. F. Moore, secretary, Nov. 25, 1921:)

Approximately 400 of the leading concerns are included in our membership. The capital invested runs into the hundreds of millions, five of our concerns alone being capitalized at over a million in the aggregate. I should say that our membership includes very close to a 100 per cent of the business enterprises of the city.

YORK (PA.) CHAMBER OF COMMERCE,
September 7, 1920.

The board of directors of the chamber of commerce put themselves upon record against the official adoption of the metric system in the United States.

CITY ASSOCIATIONS.

Master Builders' Association of Boston, Mass.
Hydraulic Society, Chicago, Ill.
Manufacturers' Association of Erie, Pa.
Muskegon Employers' Association, Michigan.
Pueblo (Colo.) Manufacturers' Association.

Compressed Air Society of Quincy, Ill.
Rubber Manufacturers' Association of Trenton, N. J.
Prominent manufacturers of San Francisco.
Manufacturers of Worcester, Mass.

THE MASTER BUILDERS' ASSOCIATION OF BOSTON,
August 4, 1920.

Re the efforts being made by the World Trade Club of San Francisco to establish the metric system in place of the present system of weights and measures existing in this country. The board of directors of this association is strongly opposed to such a change.

(Abstract from a letter by W. H. Sayward, secretary and treasurer, Nov. 25, 1921:)

Our membership varies from year to year. It is now about 200.

We have several concerns in membership, each of whom in normal times has an average of several thousand employees.

From a very superficial survey I would say that in normal times our full membership would employ 30,000.

The work of our members is done within the limits of New England and very considerably within 100 miles of Boston.

We certainly can be counted upon as sustaining the purpose of your organization as we understand it, namely, "the maintenance of our basic English units of weights and measures."

THE HYDRAULIC SOCIETY,
Chicago, Ill., September 20, 1920.

Resolved, That this society is opposed to the movement to force the compulsory adoption of the metric system in this country, and that a copy of this resolution be transmitted to the appropriate congressional committee having in charge the legislation that was introduced in the last Congress with this purpose in view.

(Abstract from a letter by C. H. Rohrbach, secretary, Nov. 4, 1921:)

The following information concerning this society is submitted: Membership, 28; employees' membership controls 30,000 to 35,000.

Capital invested by members, $200,000,000.

Per cent of particular field covered by membership is 80 to 85 per cent.

MANUFACTURERS' ASSOCIATION OF ERIE,
Erie, Pa., March 30, 1920.

This question has been discussed by the officers and directors of our association, and the secretary has been directed to inform you that our association is decidedly opposed to the adoption of the metric system on account of the endless confusion and great expense that will be caused by making the change, and also on account of the lack of necessity for so doing.

(Abstract from a letter by Dana E. Jones, secretary, Nov. 5, 1921:)

Our membership comprises the manufacturers of Erie City and vicinity, and we also speak for the industries of Erie County.

You will notice that the State report gives 25,848 for the number of employees in the county.

MUSKEGON EMPLOYERS' ASSOCIATION,
Muskegon, Mich., July 13, 1920.

Whereas the industries of this Nation have been built upon the English system of weights and measures; and

Whereas national legislation is proposed to make the metric system compulsory; and

Whereas such a change would cause great confusion, require enormous expense, and would be generally detrimental to business: Now, therefore, be it

Resolved, That the governing board of the Muskegon Employers' Association, representing 95 per cent of the manufacturers, merchants, and others of this

community, does hereby condemn and oppose all legislation which would provide for the compulsory use of the metric system, or which would change our present system now in general and satisfactory use.

(Abstract from a letter by W. W. Poole, secretary, Nov. 25, 1921:)

Our membership comprises some 42 manufacturers, being at least 90 per cent of the manufacturers in this vicinity.

There are approximately 7,500 employees working for our members.

THE PUEBLO MANUFACTURERS' ASSOCIATION OF THE COMMERCIAL CLUB,
Pueblo, Colo., August 18, 1920.

Be it resolved, That the Pueblo Manufacturers' Association of the city of Pueblo, Colo., do hereby condemn the efforts now being put forth to effect a change in the existing system of weights and measures. They consider such a move to be inimical to the industrial interest as well as the commercial interest of this country.

THE COMPRESSED AIR SOCIETY,
Quincy, Ill., September 18, 1920.

Unanimously voted that the society go on record as being opposed to the metric system as our standard of weights and measures.

(Abstract from a letter by C. H. Rohrbach, secretary, Nov. 3, 1921:)

The following information concerning this society is submitted: Membership, 12; employees, the membership controls 20,000 to 25,000.

Capital invested by members, $150,000,000.

Per cent of particular field covered by membership is 90 per cent.

RUBBER MANUFACTURERS' ASSOCIATION OF TRENTON, N. J.,
June 14, 1920.

A resolution was unanimously adopted opposing all legislation toward bringing about a compulsory change in the system of weights and measures now in general use in the United States.

PROMINENT MANUFACTURERS OF SAN FRANCISCO,
May 13, 1920.

We unqualifiedly condemn the efforts now being made for the compulsory adoption of the metric system. We hereby register our protest to the persistent and radical propaganda now being conducted from this city to secure compulsory legislation of the character mentioned. We are convinced that such efforts do not represent the prevailing sentiment of the substantial business interests of San Francisco.

MANUFACTURERS OF WORCESTER, MASS.,
January 30, 1920.

Be it resolved, That we, as individual manufacturers and representatives of the industrial life of the city of Worcester, Mass., do hereby condemn and oppose all legislation toward bringing about a compulsory change in the present system of weights and measures in general and satisfactory use.

PART 4.—ATTITUDE OF VARIOUS INDUSTRIES TOWARD THE METRIC SYSTEM—SOME FOREIGN VIEWS AND CONDITIONS.

THE STEEL INDUSTRY.

The total annual ingot capacity of the steel producers of the United States is estimated at approximately 55,930,940 tons.

The Association of American Steel Manufacturers, the membership of which is composed of 40 of the leading concerns in the steel industry, repre-

sents an approximate total annual steel-ingot capacity of 47,106,460 tons= 84.22 per cent of the total ingot capacity of the United States.

During the month of March, 1920, a canvass of the members of this association was made on the subject of the metric system. In reference to this the secretary writes as follows:

ASSOCIATION OF AMERICAN STEEL MANUFACTURERS,
Pittsburgh, Pa., August 13, 1920.

It was decided to ascertain definitely the present attitude of our member companies on the compulsory adoption of the metric system in the United States without prejudice to their opinions as to the merits of the system. The result of this canvass was:

Thirty-seven companies voted against the compulsory adoption of the metric system in the United States.

One company, having an ingot capacity of approximately 0.5 per cent of the total capacity represented in the Association of American Steel Manufacturers, voted neutral.

One company, having an ingot capacity of approximately 0.7 per cent of the total capacity, voted in favor.

One company, having an ingot capacity of approximately 2.5 per cent of the total capacity, did not reply.

J. C. LEECH, *Secretary.*

From the above the following figures are of interest:

	Per cent.
Against compulsory use of metric system	96.3
Neutral	.5
In favor of metric system	.7
No preference expressed	2.5
Total	100.0

THE RUBBER INDUSTRY.

In an article entitled "The London view of the 1919 crude-rubber market" (see March issue of The India Rubber World, New York) we find the following figures expressed in gross tons dealing with the crude-rubber consumption of the world:

	1917	1918	1919
England	26,000	24,000	30,000
Germany and Austria	1,000	1,000	2,000
France	10,000	14,000	20,000
Russia	7,000	2,000	1,500
Italy, Spain, and Scandinavia	5,500	5,000	7,000
Japan and Australia	5,000	5,000	7,500
United States and Canada	155,000	187,000	230,000
Total	209,500	210,000	298,000

In this industry the preponderance of the use of our system of weights and measures is shown thus:

	Tons.	Per cent.
World consumption, 1919	298,000	100
United States, Canada, and England, 1919	260,000	87.25
Other countries, 1919	38,000	12.75

In this industry the multiplicity of special machines used, the innumerable processes developed, the thousands of rubber-compounding formulas evolved by experiment and practice, the standard sizes agreed upon for all kinds of rubber goods from tires to hot-water bottles, all based and built up on our established system of weights and measures, would be affected by a change to the metric system.

The following letter from one of the largest companies in this field expresses *the feeling in this* industry:

UNITED STATES RUBBER CO.,
New York, March 4, 1921.

GENTLEMEN: The United States Rubber Co. is a member of the American Institute of Weights and Measures because it believes that the attempt to force legislation making the metric system the sole legal standard for use in the United States will cause a very large and unnecessary financial burden on the industry of this country without any corresponding advantages for the outlay; that every attempt to use the metric system to the exclusion of our present system in industries previously accustomed to the English system has been a failure; and that the present active endeavors to enforce Federal legislation is the result of what it believed to be a misconception of the wishes of the industries of the United States.

The United States Rubber Co., together with a large number of other representative corporations, believing the above to be true, is therefore supporting the American Institute of Weights and Measures in its endeavors to counteract the present activity on the part of the proponents of the metric system.

Yours, very truly,

CHARLES F. LINDSAY,
Technical Assistant to the President.

THE LUMBER INDUSTRY.

The total production of lumber in the United States for 1916 was estimated by the Forest Service, United States Department of Agriculture, at 39,807,-251,000 feet board measure (practically 40,000,000,000 board feet). Mills producing less than 50,000 board feet per year have been omitted.

For the year 1914, during which many mills were shut down owing to the stoppage of all exportation on account of the war, the following information is given: Number of mills, 27,249; approximate number of employees, 480,207; wages paid, $240,172,000; value of product, $715,941,000.

To show the practically universal use of the English system of measurement in the lumber trade I quote from United States Commerce Reports (Feb. 11, 1920):

"According to Trade Commissioner A. X. Oxholm, lumber exported by a company in northern Sweden is cut as follows: Sixty-nine per cent to English feet; 7 per cent to Danish feet (1 Danish foot equals 0.9711 English foot); 8 per cent to 'metric' feet (1 'm' foot equals 1.0936 English feet; equals one-third meter); 7 per cent to Spanish feet (1 Spanish foot equals 1.0783 English feet); 4 per cent to Dutch feet (1 Dutch foot equals 1.0768 English feet); 4 per cent to German feet (1 German foot equals 1.0639 English feet); 1 per cent to decimeters (1 decimeter equals 3$\frac{13}{16}$ English inches)."

We quote from a letter on file in our office:

"I have just returned from a trip to the major portion of all the principal countries of South America, and have made it a point to consider this subject in more than an incidental way, and my experience has been such that I would not feel justified in recommending a transfer to the metric system in handling lumber.

Yours, very truly,

V. L. HAVENS,
Editor Ingenieria Internacional."

"AUGUST 23, 1920."

The lumber interests in the United States are fully aware of this fact. Their position is indicated by resolutions quoted from the New Jersey Lumbermen's Association, the National Retail Lumber Dealers' Association, and the California White & Sugar Pine Manufacturers' Association as being opposed to the compulsory adoption of the metric system.

THE BUTTON INDUSTRY.

One of the industries seldom mentioned, whose product, however, is a necessity to every man, woman, and child, is the manufacture of buttons. While not as large a branch of our activity as some other lines, it is of importance as shown by the fact that in 1920 its business is estimated to have amounted to approximately $40,000,000.

The principal button-producing countries are the United States, Austria, Germany, England, France, and Japan. In the middle of the last century this industry was developed on a large scale in Austria, from which it spread to

Germany. Meanwhile the button factories of both England and France grew to importance; soon the United States and then Japan became prominent.

One of the very interesting things in connection with this industry is the fact that button measurements are standardized in all countries, with the exception of France, on the "inch" system. Thus in the case of Austria and Germany the English inch was adopted as standard long before either country became "metric," and is still standard in spite of the fact that both Austria and Germany have since then become "metric countries." Japan, which entered the trade later, naturally conformed to this standard, making the use of the "inch" practically universal in this trade.

The majority of buttons being round, the size of a button is expressed by its diameter. For odd-shaped buttons the diameter of the circle is given in which the shape of the button can be inscribed. The inch is divided into 40 parts, one-fortieth of an inch being called a "line." Thus a one-half inch diameter button becomes a 20-line button, etc. The United States tariff law of 1909 and preceding laws taxed buttons according to this "inch" method of designation, while the law of 1913 imposes duties ad valorem only.

To apply metric units in this country by compulsory laws to button measurements, when metric countries like Austria and Germany have found it inexpedient to do so, would seem, to say the least, very much beside the mark.

One-fortieth inch equals 1 line; one-fortieth of 25.4 millimeters (1 inch) equals 1 line, equals 0.625 millimeters. Here once again the "unhandiness" of metric subdivisions is strikingly shown, the millimeter is too large, being, in fact, 157.48 per cent of the one-fortieth of an inch.

The button industry does not want the metric system. This industry, practically the world over, is standardized. To inject the metric system would spell confusion without any possible advantage as an offset.

THE GOVERNMENT MAP MAKERS.

At a meeting of the board of surveys and maps (Department of the Interior) held in Washington, D. C., on September 14, 1920, the committee on technical standards submitted to the board a report from which are given the quotations below:

The report which was signed by its chairman, Mr. W. M. Reed, deals with the questions: "Shall maps be published on standard scales of metric or English measurements?"

We quote:

"Four of the reporting bureaus evidently employ the metric scales almost exclusively while eight on the other hand use the English system; two use both.

"Practically all maps dealing with the public land surveys of the country are made on the English measurement scales since the metric scales do not lend themselves at all readily to the chain unit on cadastral surveys.

"After due consideration of the various phases of the question, the committee has reached a unanimous conclusion to recommend to the board that the English system be adopted as standard practice.

"This decision was made not only from the standpoint of securing uniformity in Government maps, but also because the advantages of the English system over the metric are so apparently overwhelming that there seems little excuse for continuing the latter system."

The concluding paragraph of this report reads:

"It is true that with the aid of specially made measuring scales the maps can be readily used, but when it is realized that the common old foot rule divided into inches is the only implement available to probably 99 per cent of the map users, even including the engineers, it would seem that the scale of the map should be made accordingly. In other words, the map users in general will employ the inch as a unit of measurement on the map, so it seems unmistakably desirable to have this unit represent a definite member of the feet or miles which are the common units of measurement on the ground."

THE OPTICAL INDUSTRY IN ENGLAND.

In the report of the department of scientific and industrial research, 16 and 18 Old Queen Street, Westminster, London, S. W. I., dated August, 1920, is given the result of investigations made by a committee representing the following organizations:

1. The British Optical Instrument Manufacturers' Association.

2. The British admiralty.
3. The British war office.
4. The British air ministry.
5. The National Physical Laboratory.
6. The Imperial College of Science and Technology.

We give only the following quotations:

"The first matter considered by the committee was the fundamental question of unit of measurement of length.

"The statement that changing from inch to metric measurement would facilitate foreign trade was considered by the committee, but the evidence of manufacturers showed that foreign trade was affected but little by the unit of measurement used in manufacturing.

"The established practice of British lens makers has generally been to manufacture lenses on the inch basis, but, when selling them to metric countries, to quote focal lengths and diameter in millimeters, and this satisfies practical requirements.

"Substantially all materials are made and sold in terms of the inch. The same is generally true of tools.

"The standards of the British Engineering Standards Association applicable to optical instrument making are all based upon inch measurement.

"In order to avoid the confusion which would result from employing a mixed system of units, the committee decided that the unit used for optical work must be the same as that used for mechanical work.

"The committee, therefore, recommends that the British inch should be retained as the unit of length for the purpose of standardization and manufacture of all parts of optical instruments."

METRIC FAILURE ACKNOWLEDGED IN PERU.

In 1918 F. A. Halsey, of the American Institute of Weights and Measures, completed a mail canvass of representative engineers, business men, and others throughout Latin America, to whom was submitted a series of questions regarding the weights and measures used in the southern half of the Western Hemisphere.

The replies to the question revealed a general confusion caused by the concurrent use of the old Spanish and Portuguese weights and measures.

The results of this thorough canvass were published by this institute (see the Metric Fallacy, by F. A. Halsey) and were the subject of a discussion by Senor Carlos Basadre, of Lima, in the June, 1920, issue of the Bulletin of the Society of Engineers of Peru. From an extended and very fair summary of Mr. Halsey's report of the canvass, Senor Basadre concludes with the following statement of his own views, from which we quote:

"Mr. Halsey's argument is manifestly powerful and based on demonstrated facts, and not merely on theoretical considerations. Without attempting to pass judgment on the advantages and disadvantages resulting from the adoption or rejection of the metric system as the single standard of weights and measures in the United States, let us consider some of the facts established by Mr. Halsey—the failure of the metric system in South America and the idea that the old Spanish system can be brought into uniformity with the English system.

"Latin-American countries adopted some time ago the decimal system, but, with the exception of Uruguay, contented themselves with recognizing it officially without troubling themselves at all to familiarize the mass of the population with its use little by little by means of an active and constant propaganda.

"Thus in Peru, where the metric system has been recognized as the legal system since the year 1866, there has been established a fiscal tax on copper per 'short ton,' and another on cotton, wool, and sugar per 'Spanish quintal.' In Chile, where the same system has prevailed legally more or less since the same year, a tax on saltpeter is imposed by the quintal.

"What has really happened is that the metric system has become mixed, sometimes more, at other times less, with the old Spanish system, with some English measures, and with the native measures, forming a heterogeneous conglomerate, which can be classified as a third system, peculiar to each country."

SCIENTIFIC ENGLAND.

In the early part of 1920 there was prepared, but only made public in 1921, a very interesting and important report on compulsory adoption of the metric system in the United Kingdom.

This report is submitted by the metric committee appointed by the Conjoint Board of Scientific Societies. This board, representing about 50 societies covering every field of science, art, and engineering, gives to the committee's conclusions an unusual dignity and importance.

As stated in the prefactory note of the report, the committee was appointed "to consider and report upon the advisability or otherwise of compulsory adoption of the metric system of weights and measures by the United Kingdom."

The report covers, with appendices, 70 printed pages. We quote from page 17. where a letter from a prominent Frenchman is mentioned:

"In a recent letter Mr. Lallemand, than whom there is no more ardent defender of the metric system, admits that 'the usefulness of the metric system is far from being the same in all the branches of commerce and of industry.'

"On the question of the compulsory change and the time required, Mr. Lallemand writes: 'This is a very delicate matter and which requires a very long transition period. For us, after a century, this period is not yet closed; I would not care to say, however, that it will never be closed.'"

The first and basic recommendation made by the committee (p. 35) reads as follows:

"Your committee recommends: 1. That the British system of units of weights and measures be retained in general use in the United Kingdom; that no proposals for modification of these units with the object of improving their interrelation be entertained; and that no new fundamental unit be established."

A FRENCH VIEW OF OUR ENGLISH SYSTEM OF WEIGHTS AND MEASURES.

To the Editor:

We quote from the French technical publication, Produire, a journal devoted to modern machine-shop practice and machine tools, published in Paris. issue of June 25, 1920. The extracts express the views of the editor in chief of the paper, Mr. L. Descroix.

"The group formed by the Anglo-Saxon nations, being to-day industrially and commercially the strongest, does not at all care to change, at a cost which is beyond calculation, its economic and technical equipment.

"Personally, we are convinced that the metric system, nevertheless, will become, in spite of the shortcomings attributed to it, the universal system of weights and measures for scientific uses; to the English system will remain the vast field of commerce and industry.

"It is thus that the Latin countries of Central and South America. contributary as they are to the commerce of the mechanical industries of North America, are obliged to use two systems; having adopted the metric system, they support the English system, willing or unwillingly."

EXCEPTIONS TO METRIC LAW IN GERMANY.

Attention is called to the German legislation governing weights and measures, and in particular to the mass und gewichtsordnung (measure and weight ordinance) of May 30, 1908. This ordinance gives an interesting appreciation of prewar conditions in Germany, the metric country "par exellance," on account of the following provisions:

"Paragraph 6 of the mass und gewichtsordnung provides that by resolution of the Bundesrath other than metric units may be authorized in special cases, and particularly in foreign trade. The following exceptions have been made in this manner:

"A resolution of December 18, 1911, authorized the use of English weights and measures (save weights used in determining wages) for the manufacture of and import and export trade in textiles; further, for the manufacture of and export trade in druggists' goods, and for the export trade in pharmaceutical products. The same resolution also authorized up to December 31, 1922, for the export and import trade in lumber the use of measures based on the English or adapted to the old French, Rhineland, or old Swedish foot.

"A resolution of June 20, 1913, authorized the use of English weights in the *export trade in seeds.*"

Furthermore, "local terms" exist. The "morgan" is commonly used by the rural population as a land measure. It usually represents 25.5 acres. The pound or "pfund" is in very common use in retail trade; so is the one-half and one-fourth pound (1 pound=one-half kilo); so also the "zentner" and "doppelzentner."

As in other countries the nautical mile or "semmeile" of 1,855 meters (meter equals 1.093 yards) is universally used by seafaring men. The land mile or "landmeile" is in less common use.

The above information can be found in Commerce Reports, January 19, 1921, issued by the United States Department of Commerce.

SOUTH AMERICAN COUNTRIES.

The confusion which a dual system of weights and measures imposes on a country is strikingly illustrated by the conditions existing in the South American countries, which countries are nominally metric.

In the Metric Fallacy, published by this institute in 1919, copy of which has been handed to your committee for reference, are reported the confused conditions existing in many South American countries based on an extended investigation.

The United States Department of Commerce in 1920 caused a similar investigation to be made through its consuls. Some of these answers were published in Commerce Reports. Recently the "unpublished" reports were made available to the public for inspection.

In these two sources of information are named the following countries as suffering from confusion due to a double and in many cases a triple system of weights and measures: Argentina, Bolivia, Brazil, Chile, Colombia, Costa Rica, Cuba, Dominican Republic, Ecuador, Guatemala, Haiti, Mexico, Nicaragua, Panama, Paraguay, Peru, Porto Rico, San Salvador, Spanish Honduras, Uruguay, and Venezuela.

PART 5.—THE ENGLISH AND THE METRIC MEASURING SYSTEM—A COMPARISON.

PREFACE.

The fundamental importance of a system of weights and measures is, as a rule, not realized by the individual for the simple reason that the system has become automatically a part of his thought activity. He uses the system's units of length, weight, and volume to visualize things, descriptions, expressions, conditions, relations, events, values, abstract facts, and natural laws. His familiarity with them has become a habit, and he uses them subconsciously. They have become in fact a part of his mental equipment. Thus, they are taken for granted.

They are intimately interwoven into the business life, the home life, and the intellectual life of every human being, man, woman, and child. None can do without them. In every line of work they are used as tools, and on the system they collectively form are based all achievements, are systematized and standardized all results of thought and work.

Based on them has been gradually built up during the years the life of the nation in its multiplicity of endeavors, represented by production, invention, industry, and trade, making for advancement, knowledge, betterment, and comfort.

Now the suggestion is made that this system be changed for a radically different one, a system for which some advantages are claimed, but which has not as yet proved its superiority in the experience even of those who have accepted it.

The change from one system of weights and measures to another involves not only the stupendous task of changing the daily habits of the people but also involves the application and use of both systems during the protracted period of education incidental, to which confusion and errors are a natural consequence. Nor is such a change accomplished without an enormous effort, which spells a cost practically beyond computation.

In the face of such conditions it behooves us, therefore, to examine very carefully the merits of the system of measurements offered to us in order to properly balance the advantages to be gained against the disadvantages so very evident. Such a comparison will be found in the succeeding paragraphs.

A COMPARISON.

The metric system was, no doubt, at the time the eminent scholars conceived it, an earnest effort to create a scientific system of weights and measures. Unfortunately in those days industrial development was in its infancy, and the men charged with the task having no practical considerations to guide them brought out a system based purely on theoretical lines.

Since then conditions have changed. Industry has claimed an increasingly important position and has enlisted in its service an ever-growing number of individuals. This multitude of artisans, in whose hands any system of measurements is but a tool like any other, has progressed or lagged behind according to the handiness and convenience of the system imposed upon it. To-day the great industrial nations are the United States and Great Britain, both of which have resisted the introduction of the metric system as an implement lacking the qualities so necessary for rapid development. This does not imply that the English system of measurements is perfect. Some of its units and subdivisions have become obsolete by disuse. This is as it should be. It is a matter of evolution and growth stimulated by experience and changed conditions and applies to most criticisms of this system.

MEASURES OF LENGTH.

We have as units of length:

1 yard = 0.9144 meter.
1 foot = 3.048 decimeters.
1 inch = 25.4 millimeters.

And conversely:

1 meter = 1.0936 yards.
1 decimeter = 3.937 inches.
1 centimeter = 0.3937 inch.
1 millimeter = 0.03937 inch.

A study of the inch-foot-yard and centimeter-decimeter-meter will show at once that the former three dimensions harmonize perfectly for practical use, while in the latter the unit subdivisions of the meter represent too great a step from the meter itself. In the inch and centimeter the same defect is apparent to which is added the indivisibility of the centimeter as compared with the inch. To the mathematician this is a matter of indifference, but not so to the workman. Divide the inch into one-thousandths and the millimeter into one-hundredths, as required in work of precision, and the metric unit is too small.

The one one-thousandth of an inch by means of the micrometer is used by the workman as easily as the inch itself, while the one one-hundredth of a millimeter, which is about 40 per cent of the former, requires an especially developed touch to be readily perceived. Thus the former dimension becomes a handy unit while the latter lacks this characteristic. In work of precision to cut down to one-half the allowable limit as a general rule doubles the expense of production. On the handiness of the tools he uses depends a workman's output. This explains why the American workman has made a success of the system of interchangeable parts and thus has made possible standardization in practically every line of endeavor.

There is no metric unit comparable with the foot. This English dimension is used so universally that it would be a hardship to use the meter in its place.

The kilometer (1,000 meters) is the largest unit of length and is equal to 0.631 mile and conversely, 1 mile equals, 1.609 kilometers.

The nautical or sea mile equal to 1.853 kilometers, and being used universally by all maritime agencies the world over, will probably never yield to the kilometer, because it is based on a rational and, for purposes of calculation convenient basis. Sixty nautical miles are equal to one degree of the earth's circumference at the equator and therefore 1 nautical mile equals 1 minute of the arc.

MEASURES OF AREA.

The common units are the square foot and the square inch and in the metric system the square meter and the square centimeter.

1 square foot=0.093 square meter.
1 square meter=10.764 square feet.
1 square inch=6.452 square centimeters.
1 square centimeter=0.155 square inches.

The multiple units in our system are the acre and the square mile, several lesser multiples being very little used and practically obsolete. The metric multiple units are:

The arc=100 square meters=0.0247 acre.

The hectare=10,000 square meter=2.4710 acres.

The square kilometer=1,000,000 square meters=0.3861 square mile.

Here especially is noticeable the great difference in the values of units between the two systems. The English units evolved by experience and antedating the creation of the metric units have no convenient equivalents in the latter system.

MEASURES OF WEIGHT.

The unit of weight in the metric system is the kilogram, equal to 2.2046 pounds. That this unit is an unhandy one because too large is proved by the constant use in metric countries of the one-half kilogram as a substitute unit, which is called the pound in every day retail transactions in France, Belgium, Germany, Italy, and Switzerland, and such expressions as one-half and one-fourth pound are common in these countries at the present day. The tendency to use old local units is admittedly still pronounced in most European countries.

For goods handled and traded in bulk we have used the long ton of 2,240 pounds, but experience has shown that the short ton of 2,000 pounds is handier, and this latter unit has displaced the former to such an extent that the long ton is being used less and less and will soon be obsolete, showing clearly the adaptability of the English system to conform to changed conditions.

The metric ton of 1,000 kilograms is equal to 0.9842 long ton and equal to 1.102 short tons. It corresponds, therefore, closely to the long ton or the unit we are discarding.

A few words may be added here on troy and apothecaries' weights and on the carat. These units have been devised for special purposes where particularly small subdivisions are required.

The troy pound is never used, but its subdivisions are employed to weigh gold and silver only; its smallest division is the grain. The grain is a uniform standard of weight, the same for the avoirdupois, troy, and apothecaries' pound. The former has 7,000 grains, while the latter two, each have 5,760 grains.

The apothecaries' pound or rather its subdivisions, are used only by physicians and druggists.

The carat is used only to weigh diamonds. Recently this unit was standardized and its value defined as 200 metric milligrams, showing clearly that for this purpose the decimal division of the metric gram was not suited. Though expressed in metric terms it is not a metric unit.

These special units covering small restricted and particular fields are a thing apart from the broad general scheme of weights and measures and bear no controlling influence on same.

MEASURES OF VOLUME (DRY).

For units of volume (dry measure) we use cubic yards, cubic feet, and cubic inches while the metric units are the cubic meter, the cubic decimeter, and the cubic centimeter. They compare as follows:

1 cubic yard=0.7645 cubic metre.
1 cubic foot=28.317 cubic decimeters.
1 cubic inch=16.387 cubic centimeters.
1 cubic meter=1.308 cubic yards.
1 cubic decimeter=0.035 cubic foot.
1 cubic centimeter=0.061 cubic inch.

While the cubic meter is considerably larger than the cubic yard, its subdivisions are so small that we have practically no approximate equivalent for the cubic foot and the cubic inch, units which have become indispensable, as shown by the far wider application they enjoy than the cubic yard. The wide divergence between them and the metric subdivisions, which would have to be used in their place, points prominently to the unhandiness of the latter.

A unit for dry measure used extensively by the vast farming community of the country and those connected with its trade is the bushel. The standard United States bushel is a measure in cylinder form 18½ inches in diameter, 8 inches deep, containing 2,154.42 cubic inches. One bushel equals 4 pecks of 8 quarts each, with 2 pints to the quart.

Because of the greater convenience of measuring many farm products by weight, especially when handling very large quantities, the practice has developed of adopting units of a many ounces, as, for example, 60 pounds for potatoes, 56 pounds for wheat, etc., and selling these units by weight. These weight unit are approximations of the quarter bushel. In view of the inherent character of the bushel standard, which the farmer thinks consciously, the weight unit which permits the buying and selling of farm products by weight offers a useful purpose.

MEASURE OF WEIGHT (LIQUID).

When we consider liquid measures, we find as the base the gallon which equals 3.785 liters, the metric unit. Conversely the liter equals 0.264 gallon.

The gallon is the largest unit. We have no multiple units of the gallon, because no need for such has developed, while in the metric system we find one hectoliter equals 10 liters and one kilolitter equals 100 liters. These multiple metric units are confusing because of the limited call for their use.

On the other hand, experience has shown the need of a great many subdivisions of the gallon, hence we have quarts, pints, and fluid ounces, a field which is very nearly covered by the decimal parts of the liter.

BINARY AND DECIMAL DIVISIONS.

During the centuries preceding the invention of the metric system, which system was put together in the eighteenth century, systems of weights and measures were evolved by the various peoples living separated and apart from each other. Invariable such efforts were based on the binary system of division. The reason for this is plain. The mind works logically in that direction. Taking a measurement, be it length, area, or weight, what is more natural than to halve it, then halve each part again, and so down to the size which, for the problem before it, becomes the quantity wanted? This method presents the quality of ease and handiness, thus the path of least resistance is followed.

The method adopted by the metric system is to divide the original measurement or unit by 10 and then express the quantity required as a multiple of one-tenth. In other words, we compel the mind to travel in one direction and then retrace its steps.

A good example of the tendency to binary division is found in metric European countries where the expressions pound, half pound, and quarter pound are much used in retail trade to indicate respectively one-half, one-quarter and one-eighth kilogram, the correct values for these expressions being in the order named 500, 250, and 125 grams.

Individual units of the English system, such as the inch, foot, yard, and mile, are often divided decimally to serve a given purpose. This must not be confused with the decimalization of a system which means the establishment of a decimal ratio between the units themselves.

CONCLUSION.

Briefly stated the metric system is devoid of the English system's handiness and convenience; its units are either too large or too small for the everyday requirements of industry.

From the English system many subdivisions have been dropped, having outlived their usefulness, thus proving the English system's adaptability to the requirements of progress. The metric system, on the other hand, presents a rigid structure incapable of modifications and requiring conditions to adapt themselves to its use.

IMPERFECTIONS AND DEFICIENCIES OF THE METRIC SYSTEM.

To the question, What specific advantages does the metric system offer to the mass of the population in their daily transactions? no answer has been given. The witnesses have dwelt in general terms on what they contended to be the merits of the system.

There are no specific advantages to the average citizen. The scientist who, as a rule, uses a system of weights and measures in the abstract only can and does use this system when its use is handier for him than the use of another system. He claims for himself the privilege to follow the path of least resistance, but denies it to those who have not found it to possess the elements of convenience.

The metric system can never get over the immense disadvantages that 10 has only the factors 2 and 5, whereas 12 has 6, 4, 3, and 2.

The binary division of a unit into halves, quarters, eighths, etc., is the universal natural system. The division and subdivision of units by 10 is artificial. English units are divided binarily and can be divided decimally when such division is indicated. Metric units can be divided only decimally.

Metric units are either too large or too small and, therefore, lack the convenience required for everyday use. The step from unity to one-tenth is too great to recommend it for universal use.

The metric system possesses not even approximate equivalent units for important English designations constantly used, such as the foot and the inch.

The metric system is a misfit as applied to common requirements. It was arbitrarily conceived on a decimal basis and its units were rigidly interrelated, while the English system grew out of actual requirements and has adapted itself to changed conditions created by progress.

Metric terms will be difficult to assimilate, belonging as they do to a foreign language, while the terms of our present system form an integral part of the English language which it would be impossible to eliminate.

The claim that the adoption of the metric system in this country is inevitable has been iterated and reiterated by metric faddists since the early days of the Republic. The trouble with the claim is that it has never been supported by anything more substantial than mere assertion.

If by inevitable is meant that the metric system will slowly assume a dominance in the United States, the answer to this assertion is that in no country has it won its way on inherent merit, which is the only legitimate way. Compulsory laws were needed to make it possible. Its only conceivable growth in this country will be through evolution conditioned on whatever merit it may have.

Mr. STUTZ. I desire to present, for the consideration of the committee, but not to be made a part of the record, a pamphlet, entitled, "American Institute of Weights and Measures, February, 1921," containing a list of officers, counsel, and members.

For the same purpose I also desire to present copies of Bulletin No. 10, of the American Institute of Weights and Measures, second edition, June, 1921.

The CHAIRMAN. Very well. They will be filed in the custody of the clerk of the committee, for reference and use by members of the committee.

Mr. STUTZ. Reference has been made in our brief, which I have submitted, to "The Metric Fallacy," which has been printed by the institute, compiled by Mr. Halsey. I have here three copies of that publication which I would like to file with the committee. This is the second edition of the book. In our brief we have referred to various pages of this publication.

The CHAIRMAN. They will be received and filed with the clerk of the committee.

Mr. STUTZ. I would like now to testify in this matter as a personal witness. I would like first to speak of the qualifications which I think entitle me to speak on this bill.

Born in Italy, of Swiss parents, I was educated in Switzerland, at the Polytechnic School in Zurich, and brought up in the metric system. Coming to the States (naturalized in 1890) I was forced to learn to use the English system.

After about nine years, as sales engineer for an American concern, I traveled extensively in Europe, selling and installing American machines. I then became chief engineer and works manager of a manufacturing concern in Alsace, and there for about four and a half years I used again the metric system, having business relations with all the countries of Europe.

While so engaged I came to the States to buy American machines for use abroad, installing them there for my own uses. Returning to this country I again took up the use of the English system.

Thus, I have used each system twice, each time for a period of years, and I think am fairly well acquainted with both. I was occupied successively as machinist, draftsman, master mechanic, works manager, chief engineer, and consulting engineer. My experience covers mechanical, electrical, and chemical

engineering. During the war I was attached to the Nitrate Division of the War Department, stationed in Washington.

Early in my experience with the use of the English system I realized the fundamental difference between that system and the metric system. This was especially impressed on me after having sojourned in the States for about nine years I took up engineering activities again in Europe. I realized then that the difference between the two systems consisted in this—that the units in one were especially prominent due to their handiness in use, and they fitted in especially well with the requirements of everyday as well as with technical problems.

A system of weights and measures is to the workman nothing but a tool, just like any other. And according to the kind of tools that you hand him he can produce either better work or work not as efficient.

The metric system I soon found had this drawback: To begin with, it was a rigid system; its units were either too large or too small. And in addition to that the fact that there were no binary divisions was quite a handicap. For instance, in designing machinery it is always required to halve dimensions, to quarter them, in order to bring the parts into proper relation.

In the metric system with dimensions expressed in figures which do not admit of binary division, we very soon begin to have figures with a lot of decimal divisions. When you add to that the requirements which are necessary for a certain amount of precision, we arrive at such small decimal divisions that a workman in the shop is not able to thoroughly comply with them.

My experience has been, for instance, that in fine machine work a thousandth of an inch, which is commonly used here, and which is the average limit of precision in ordinary machine-shop work, is a very handy division, and a division which is very readily used by means of the micrometer.

I have been asked, when abroad, to construct machines with a limit of a hundredth of a millimeter. That is only forty per cent of a thousandth. There I have found that in the use of the micrometer a thousandth of an inch is about the limit of the average mechanic for sensitiveness; and when you get down to hundreths of a millimeter he is not sure whether he will get the proper dimensions.

While I was abroad I had to compete with machines built in the States. Labor in Europe was a great deal lower, and it was always a great wonder to European manufacturers how it was that American machines, which were built with a high cost of labor—machinists working for instance for from $3 to $6 a day, speaking of prewar conditions—how it was that machines built under such conditions could compete with machines built in Europe where the wages paid were, at the maximum, 75 cents to $1 a day. The answer to that riddle was simply that American machines had higher precision, greater efficiency, therefore a larger output, and for that very reason commanded a higher price. Accordingly there still remained an advantage in the American machine.

Something has been said, I think by the witness Molitor, as to the scales required in the metric system, that there were only about six or eight, and they were quite sufficient for all work. You start with the scale one-half, then one-fifth, one-tenth, one-twentieth, and so on. The trouble is there is no scale of one-third or one-fourth, and in machine designing those are the most important scales. It is my experience that in designing machines to a one-quarter scale the designer is able to perceive better the necessary sizes than if he were designing to one-fifth. With the one-fifth scale in designing machinery there is always the difficulty of properly visualizing the relation of the parts. So that the omission of that scale is a very serious matter as far as this one particular thing is concerned—the designing of machinery in general.

I have found that great objection has been made to the English system because of certain units which apply to particular callings and trades. For instance the average man never uses the grain. If a boy is apprenticed to a jeweler, however, he will be required to know all about the grain and multiples of a grain, because he uses those, particularly in the handling of precious metals. The troy pound is never used.

When we talk about the sea mile we find a knowledge of the sea mile and its special divisions is not required by the average man, but anybody qualifying for, or studying that particular line, the sea-faring line, will as part of his mental equipment make himself acquainted with those particular subdivisions required by his calling.

The CHAIRMAN. Pardon me. I do not want so much technique. That is in here; and it will not be readily understood by the committee. It is the general purposes of the measure before us in which we are interested.

Mr. STUTZ. All right. Referring to the matter of compulsion, compulsion was used to force the metric system in foreign countries. The reason for that was that foreign countries had a diversity of systems; here we have uniformity. Therefore compulsion does not apply here. As a result the old measures still persist in many countries, and besides we find exceptions to the metric laws. I think I have pointed out in my brief that the German laws make many exceptions and permit the use of English measures, the old German measures, and others. That shows that they were obliged to make concessions to the requirements of trade.

Another example is the textile industry in France. Shortly after the metric system was invented the French language and French influence became dominant. Since then, however, the English language and the industrial development and trade of the English-speaking peoples have become dominant. They are steadily forging ahead and with it the English system of weights and measures. I even venture the opinion that in another century South America will use practically only the English system, and that is due to the increased relations in trade. Economic conditions pay no attention to compulsory laws.

In talking about retail transactions, Mr. Bearce, from the Bureau of Standards, at page 145 of the record, speaks of the difficulty a purchaser would have when buying a steak weighing 1 pound 13 ounces, price 47 cents per pound. How much better off would he be if the butcher gave him a steak weighing 1 metric pound and 136 grams at 52 cents per metric pound? He would first have to remember that 1 kilogram, being 2 metric pounds, would cost $1.04. Then he must remember that the metric pound is 500 grams, and therefore the weight of his purchase is 636 grams. Now, multiplying 636 by 52 and moving the decimal point three places would enable him to obtain the value of his steak. It means a calculation in either case, and I do not see any advantage to the customer in the matter.

Mr. Bearce fails to show reasons why the metric system would be of benefit to the artisan, the worker in the factory, the farmer, or the housewife. He simply assumes the metric system to be better, but does not show wherein it would be better.

Referring now briefly to some of the unhandiness of the metric system, when I was abroad this summer and last year, I found that in large cities like Paris, Brussels, Cologne, grocers advertised their wares in pounds, gave the price per pound, and sold it by binary divisions of the pound. Those are all supposed to be strictly metric countries. It is true the pound was considered as 500 grams. That was the law. But it shows that the kilogram is really too large for any transactions because the people prefer to use the pound; they want a smaller unit. The kilogram is too big for them.

The bill provides for the buying of goods, wares, and merchandise according to the metric system. Witnesses for the bill have dwelt sparingly on simple transactions of daily life, but there are a great many other transactions to which I would call attention.

Suppose a sale was made of a gas engine built to the English system to develop 2,600 horsepower, a rather expensive piece of machinery. This sale would be made conditional on the engine conforming to written specifications forming part of the sales contract, wherein, for instance, the condition is specified that the engine should deliver one horsepower per hour on a certain number of cubic feet of gas of a calorific value of a stated number of British thermal units.

If such a contract should become a subject for litigation, would it be thrown out of court as illegal because the specification does not speak of metric horsepowers, cubic meters of gas, and calories? Arguments can be presented on both sides, because the provisions of the bill are not sufficiently explicit.

The multiplicity of such transactions is simply enormous, and covers all the various transactions in commerce and industry.

Speaking now of the matter which was presented by Mr. Miller, works-manager of the De Laval Separator Company, at, I think, page 5 of the record, he testified that the cost system installed at his factory showed practically no expense due to the use of the metric system.

According to his own testimony he buys material in the English system, because that is the only way he can buy it in the open market. He takes it into his factory, changes the dimensions, transfers the English dimensions

into metric dimensions, builds his machines, and then is ready to sell the product.

What does he do when he sells the product? Does he sell it in the metric? No. What he does then is to go back to the English system. In order to emphasize that I would like to introduce and leave with the committee, for reference only, this catologue [indicating] and also another one.

The CHAIRMAN. Suppose you identify them, so that the record will show what they are.

Mr. STUTZ. No. 100, "The De Laval Method of Purifying and Reclaiming Oils." Also No. 200, "The De Laval Method of Centrifugal Clarification of Varnishes and Pigment Goods."

The dimensions of his machinery are all given in English units. The capacity is given in gallons, showing that he goes from the English system to the metric system and back again to the English system.

If this bill should pass, every manufacturer in the country using the English system would have to do exactly the reverse. He would have to buy his material in metric dimensions. Being equipped to use the English system he would have to use the English system in his factory, and then in selling change all his dimensions back into the metric.

I do not think anybody would consider this an efficient method of producing and selling goods of any kind. Of course that is a matter of personal preference. But it does take time to change from one system to another in accounting in the shop, etc. If the cost system does not take special cognizance of this very fact it will not show any difference in price as far as the product is concerned. In other words, it all depends on how the cost system is handled, whether it shows any cost due to the changing from one system to another.

The CHAIRMAN. Have you not covered that entirely in your brief?

Mr. STUTZ. Not quite.

The CHAIRMAN. We do not want to have any duplication.

Mr. STUTZ. No; I am not duplicating; I am trying to keep it as short as possible.

The CHAIRMAN. Proceed.

Mr. STUTZ. Much has been said about the changing of English to metric figures, and I would like to put in the record a short calculation I have made, which will show that.

(The calculation referred to is here printed in full as follows:)

THE CHANGING OF ENGLISH TO METRIC FIGURES.

Witnesses who have appeared before your committee have repeatedly insisted on the ease with which English designations could be replaced by metric ones in the sale of articles manufactured to our accustomed system.

While this can be done in some instances, such as designating a steel bar ½ by 1¾ inches as 12.7 by 44.5 millimeters, this problem presents some difficulties pointed out in the following example.

The purchasing agent for a manufacturer of rubber goods in looking up quotations on carriage cloth, duck, sheetings, and tire fabrics may find the following figures mentioned: Sheetings, 40-inch, 48 by 48, 2.35-yard, at $0.36 per yard.

The quotation tells him that this fabric has 48 warp threads and 48 filler threads per inch. The fabric is 40 inches wide, a piece 2.35 yards long weighs 1 pound, and the price per yard of length is 36 cents.

To write this quotation in metric figures, centimeters will be used instead of inches, meters instead of yards, and kilograms instead of pounds: 1 inch=25.4 millimeters (1 centimeter=10 millimeters), 40 inches=40×25.4=1,016 millimeters=1 meter 16 millimeters.

To find the number of threads per centimeter: 25.4 : 10 as 48 : x, and x=18.9 threads per centimeter.

To find the length of sheeting weighing 1 kilogram: 1 kilogram=2.2046 pounds and 2.35 yards of sheeting weigh 1 pound; then 2.2046×2.35=5,1807 yards in 1 kilogram. Since 1 yard=914.4 millimeters and 1 meter=1.0936 yards, 5.1807 yards=5.1807×914.4=4 meters 737 millimeters. Therefore, a piece of sheeting 4 meters 737 centimeters long weighs 1 kilogram. If 1 yard costs 36 cents, then 1 meter cost=1.0936×36=39.25=39¼ cents.

The quotation now will read: Sheetings, 1 meter 16 millimeters, 18.9 by 18.9, 4 meters 737 millimeters at $0.39¼ per meter.

Mr. STUTZ. I would like to dwell very briefly on a small subject which will not take very much time.

The CHAIRMAN. Very well; proceed.

Mr. STUTZ. The point is this: We have had about seven or eight chemists as witnesses. In chemical manufacture the manufacturing chemist uses by preference the English system, as is shown in the brief, and this is simply due to the fact that chemical equation all go by atomic weights, and it makes no difference whether you use metric or English units of weight. The formulas will apply to either just as well.

In a paper placed in the record by Mr. B. C. Dailey (pp. 146–148) it is argued at length that the metric system is necessary for success in war. In the Franco-German War of 1870–71 the metric system did not save France against the aggregation of German States all having different systems of weights and measures. In the Spanish-American War the metric system did not help Spain. In the World War Germany, a metric country, was defeated. After the World War an imperial British commission decided against metric adoption. Our own departments of the Navy and Army are against compulsory metric adoption. Success in struggles between nations depends on many other factors, and the arguments by Mr. Dailey can be dismissed.

As to foreign trade, much has been said by metric advocates as to the necessity of the metric system in foreign trade. My personal experience in selling American machines abroad was that I never lost a sale due to machines being built to the English system. It was always a question of credit, delivery, and price.

Some witnesses, like, for instance, Mr. Williams, based their opinions on the use of the metric system abroad on observations during extended travels. These observations are very misleading. In simply traveling through a country it is impossible to get next to the peculiarities and characteristics of the people. Whenever you talk to somebody in France and ask them about the system, they say, "Yes; we are a metric country." But the minute you start to go into details you will find exceptions here and there, etc.

For instance, when I was in Belgium last year I said to an engineer: "Your country is metric." He replied, "Yes; since 1830; but," he said, "you go to any hardware store and find out what measures you can buy." I went into a store there and these [indicating] are the scales or rules I bought, which are used in Belgium to-day. This scale [indicating] is metric on one side and English on the other. This scale [indicating] is metric on one side and has the old Belgium inch on the other. This [indicating] is metric on one side, with the old Paris inch on the other. I asked the dealer, "Why do you keep these scales?" He said, "We have calls for them right along." And I found then that carpenters, for instance, and masons in Belgium will not use the metric system, but they use the Belgium inch, as indicated by this scale here.

While in Paris I was shown a French catalogue which gave pipe dimensions in English figures, and I was told that even in France pipe and pipe fittings were made to the English system. The reason for it, it was thought, was that because this commodity was first imported from England, and was universally used, it was impossible to design them to metric dimensions and then make them fit with the parts already in use. The English system for designating sizes of pipe is prevalent in Belgium, in France, and in Germany. Those pipes are all interchangeable, and the various fittings will fit whether made in one country or the other, because they are all made to the English system.

I want to emphasize the unhandiness of metric units. That is strikingly illustrated in a circular which Prof. Bingham, one of the witnesses before this committee, has sent broadcast only a few weeks ago. I want to read just a very short paragraph from it, in which he says:

"The president of another firm writes, 'Some years ago we adopted the metric system in both the measurements of our apparatus and the weights in selling chemicals, and carried it out for about a year. At the end of this time we learned that it was impossible to force our system on our customers, and that our humble efforts made very little progress in educating the country, so we went back to selling chemicals by pounds as asked for.'"

The fact that the metric system is unhandy has been proven by the advocates of that system by the fact that they have suggested that instead of the kilogram we should use the metric pound. They admit, therefore, that the kilogram is too big. I have also heard that the metric foot is advocated, one-third of a meter, showing the meter is too large and that they would like to have a smaller dimension.

While I was in Belgium last year the suggestion was made that the metric system should be changed in this manner: That the meter should be 1,20

millimeters, the decimeter 120 millimeters, and the centimeter 12 millimeters, which would make a centimeter nearly one-half inch. When I asked what was the reason for that, they said that in this way the meter could be divided just like the foot and be subject to binary divisions.

I have also heard it mentioned that we should make 25 millimeters the metric inch. One of the witnesses has proposed the metric bushel to be 35 liters. If we should adopt these metric suggestions we would have really three systems. We would have the English system, we would have the metric system, and we would have what we might call the metric English system. We would have a metric foot, a metric inch, and a metric bushel. In other words, we would have three systems, where to-day we have only one. This certainly would not tend toward uniformity.

Another peculiarity I found when I was in France was in the matter of the pronunciation of the metric units. American engineers in France do not say kil-o-mēter; they say kil-ŏme-ter. If that pronunciation should prevail you would never know how it would work out. We would have to say de-cäm-e-ter, and cen-tăm-e-ter. In other words, we would have all sorts of pronuciation.

The promoters of the metric system have insisted that the names given to their units should absolutely be maintained, and that being maintained the units of the metric system will be universally understood all over the world. But Greece, for instance, has thrown all these names over. They call the meter "pecheus," the kilometer "stadron," the centimeter "dagtyon," and decimenter "palame," and the hectoliter "koilon."

The reluctance to accept the metric system is laid by its advocates to gross ignorance, as alleged by Mr. Molitor in his testimony at page 68; to inertia, to conservatism, to shortsightedness, and to lack of initiative. They also speak of world uniformity. World uniformity in other things has been tried. For instance, it was thought that it would be very nice to have a universal language. That has been worked out. First, there was "Volapük," and then "Esperanto." At one time it was considered that there was no question but that one universal language would be simple to have. But that is all a thing of the past, because on looking into the matter thoroughly the enormous difficulties presented by such an effort have been realized, and these suggestions have gradually died down.

So that the matter of a system of this kind becoming universal is simply one of its merits and the evolution of events. If it has the merits that are claimed for it, it will, by its own weight, gradually make its place in the world and become universal in spite of anything anybody can do. But until it has proven its advantages it will not become universal, and I think it would be a very great mistake if we should discard the uniformity which we now have for either a dual or a triple system.

This concludes my testimony. I would like to present for the record a short brief by Mr. Frederick A. Halsey, author of "The Metric Fallacy," which covers points that I have not touched on and which are elucidated in a different manner from what the record shows.

The CHAIRMAN. Mr. Halsey's brief will be made a part of the record.

(The brief referred to is here printed in full, as follows:)

BRIEF IN OPPOSITION TO SENATE BILL NO. 2267 FOR THE ADOPTION OF THE METRIC SYSTEM, BY FREDERICK A. HALSEY, AUTHOR OF "THE METRIC FALLACY."

The SUBCOMMITTEE OF THE SENATE COMMITTEE ON MANUFACTURES.

GENTLEMEN: Herewith I hand you my answer to the arguments that have been advanced in support of Senate bill 2267 for the adoption of the metric system in commercial transactions. Some of these arguments are not germane to the bill, and the replies to them may, therefore, be looked upon as unnecessary. Nevertheless, the arguments being in the record, it has seemed to me important that they be replied to, and the more so in that, should no replies be submitted, the advocates of the bill will naturally believe and represent that there are none.

In accordance with the expressed wish of the committee, I have, however, restricted myself to the applications of weight and measure to the affairs of everyday life, and, to shorten what is at best a somewhat lengthy paper, I have frequently contented myself with statements of fact followed by mere citations of sources of proof.

THE PREVAILING IMPRESSION AND THE FACTS.

On its cursory examination the metric system is an alluring thing.

Repeated investigations that have gone below the surface and investigated the results that have followed the many attempts to adopt the system have shattered this ideal. The alluring surface view has been presented to the public for generations, and on it the favorable opinion is based. The facts disclosed by these researches are of comparatively recent discovery, they have received in comparison but little publicity, and they are, in consequence, known to relatively but few.

They do not seem to be known by those who support the metric system with claims that were in some cases disproven 20 years ago. Thus they confront us with the fact that we use one mile for land and another for sea measurement, ignoring the fact that the English nautical mile is the unit used by every nation that sails the seas, and that they use no other, the use of the kilometer being restricted to land measurements.

Again, they tell us that all the world, except the English-speaking portions of it, have adopted the metric system, when the investigations of the National Industrial Conference Board have shown that those who use neither the English nor the metric system exceed in number those who use both together. On the next page is given, in diagrammatic form, the finding of the National Industrial Conference Board from the report of that board, page 19, and, contrasted with it, a map of the world, published broadcast by the World Trade Club, and showing graphically the claim of the metric party. Other examples of this failure to acquaint themselves with established facts appear in the sequel.

It is by such unfounded claims—for there are many others—together with the prevailing lack of knowledge of the facts, that 100,000 petitions and numerous resolutions of associations in favor of the system have been obtained.

It is to be noted, moreover, that this report of the National Industrial Conference Board is approved by the signatures, without reservation, of two members of the Council of the American Metric Association.

THE SYSTEM AS A WHOLE HAS BROKEN DOWN EVERYWHERE.

The first thing that we learn from investigation is that the system as a whole has broken down everywhere. The system in its entirety includes the division of the circle into 400 degrees and the decimal division of the calendar, the clock dial, and the mariner's compass, and, for the purposes of the navigator, these are essential portions of the system. We find, however, that they are used nowhere.

WHAT DOES THE BILL MEAN?

This fact raises at once a fundamental question regarding the meaning of this bill; for, while the above-named portions of the system are not in fact used, they have never been formally abandoned and remain integral and, indeed, basic features of the scheme, the derivation of the measure of length from a survey of an arc of a meridian having been for the purpose of adapting the kilometer to the measurement of distances at sea. While, however, these features of the system have been a complete failure, the argument in their favor is identical with and just as strong as for the surviving portions. The revival of the 400° circle is frequently advocated, and, for the purposes of the mariner in calculating longitude and time, this would carry with it the decimally divided day and compass.

Moreover, the International Bureau of Weights and Measures at Sevres, France, has recently established additional metric units of which few of our people have ever heard. These units are the sthène and pièze, the former being the unit of force, for which in the English system we use the pound, and the latter the unit of pressure, for which when inflating automobile tires and in steam boilers and water-supply systems we use the pound per square inch. These practically unknown units, which are now parts of the metric system, would naturally be included in the scope of this bill. This international bureau expects from time to time to establish still other units, which will then become parts of the metric system. This bill would thus commit our country in advance to the adoption of these units and transfer legislative authority in these matters from Congress to a bureau located in France, to which we give our approval by our support but over which we have no control.

ADOPTION OF THE SYSTEM EVERYWHERE IMPERFECT.

The second thing that we learn from an examination of actual conditions is that the adoption of even the surviving portions of the system is everywhere very imperfect. There is not a country in the world that has succeeded in eradicating its old system, while in many of them the adoption of the metric system is not much more than a form, the old units remaining the customary ones in trade and commerce. So far from its being, as claimed, universal nearly everywhere, it is, in fact, universal nowhere.

This persistence of old units puts an entirely new phase on the whole controversy. The comparison heretofore has been between the English and the metric system, each considered by itself and alone. Clearly, we must compare what we have with what we will get, not with what it is hoped we will get, and the experience of the world shows that we will get a mixed or dual system, the English system remaining in use with the metric system superimposed upon it. This, in fact, is just what this bill contemplates. Providing, as it does, for the use of the metric system in commerce but not in industry, it will deliberately introduce a dual system, to which the various arguments for the metric system standing alone have no application.

THE ARGUMENTS OF THE METRIC PARTY HAVE NO APPLICATION TO THE BILL.

While urging a bill for a dual system, the arguments of its advocates ignore this fundamental feature of the bill and are worded as though it contemplated the substitution of the metric for the English system instead of its mere addition thereto. Not only do these arguments have no application to the bill as it stands, but they are destroyed by the condition that it aims to create, and which, in fact, has been created everywhere by the attempts to adopt the metric system.

Thus one argument is that school children will have less to learn. Plainly, if the old system is to continue in use it must be taught and to it the teaching of the metric system will be added, the children having more, not less, to learn.

Another argument is that the metric system having fewer units than the English system, the number of units in use will be reduced, the fact being that they will be increased to the sum of the English and metric units.

Another argument is that the numerous ratios between the English units will be done away with, whereas, in fact, they will be retained and to them the ratios between the English and metric units will be added, for, with both systems in use, conversions between them will be a frequent necessity.

Still another argument points to the greater simplicity of the metric as compared with the English ratios, the fact being that the best of the ratios between English and metric units, which this bill will introduce, are far worse than the worst of the English ratios. A few of the ratios that this bill will introduce are given under the subtitle, The metric quivalent scheme.

Again the general arguments for uniformity and simplicity are destroyed by the result of diversity and complexity.

Still again the claim that the new system may be easily substituted for the old is destroyed by the fact that no nation has succeeded in the attempt.

Finally, the claim for a saving of time in calculations becomes grotesquely ridiculous under the condition of a dual system, as a few examples will show.

THE SAVING OF TIME IN CALCULATIONS.

Under the subhead, "The use of old names for new units," an investigation of the weights and measures of Latin America by the American Institute of Weights and Measures is mentioned. That investigation brought to light in all the countries of Latin America the general use of such dual systems as this bill seeks to introduce here and following are some examples of the effect of these dual systems on simple calculations of everyday life.

The investigation showed that the system has made much greater progress in retail than in wholesale trade, the result being that merchants buy their goods at wholesale by one system of units and sell them at retail by another, and we see at once how "simple" the merchants' calculations are.

Another result of the investigation was to show that when one erects a building, his building lot is measured by the vara while his mason work is done by the meter, his carpenter work by the pulgada, his painting by the square meter and his glazing by the inch, while his piping is measured in lengths by the

meter and in diameter by the inch and, when he goes to the lumber yard for his lumber, he buys so many cubic meters of 1-inch boards.

It will be seen at once how "simple" the builder's calculations are—how simple when he calculates the cubic meters of 1-inch boards required to lay the floor, how simple when he calculates the cubic meters of 10 by 12 inch timbers required for the frame and when he determines the velocity of water in meters per second and the discharge in liters through a 2-inch pipe.

Under the imaginary condition of a complete displacement of the English by the metric system there would be no such saving as claimed. It is, of course, easy to select examples that apparently prove the claim, of which the classic one of the weight of tanks of water may be offset by a far more important one in which calculations are far more simple in the English than in the metric system, and it is easy to demolish the entire argument.

The discussion would, however, lead to a consideration of the abstract merits of the two systems, which it is desired to avoid. It would have no application to the dual system contemplated by this bill and it is therefore omitted. It has long been in print and will be supplied if desired.

If any individual will consider the proportional part of his own time that is given to calculations involving weight and measure, he will recognize that the importance of this phase of the subject has been exaggerated beyond all reason.

THE COST OF THE CHANGE.

The metric party assure us that the change will cost very little, Mr. Miller (see p. 6 of the record), saying, for example, "If won't cost them anything or, anyway, the cost will be so small that, like ourselves, they will never be able to find the cost."

The metric advocates insist that the adoption of the metric system will not involve the abandonment of all mechanical standards and the scrapping of all gages and tools based upon them, but to avoid technical subjects, of which this is one, I will here restrict myself to those weighing and measuring instruments and apparatus which are a part of our everyday life. The endeavor to estimate in dollars and cents the cost of changing these appliances would be a formidable undertaking, and in lieu thereof the following summary of the things to be changed is submitted:

MEASURES OF CAPACITY.

Simple measures of capacity are typified by the gallon measure of the grocer, the quart measure of the housewife, and the peck and bushel measures of the farmer. In this class milk bottles come also. How many of these measures there may be in the country can not be determined, but it is clear that all must be scrapped and replaced with metric measures. The British Deputy Warden of the Standards has estimated that the cost of new weights and measures for the retail trade of Great Britain would be about £2,000,000 Sterling.

With the scrapping of domestic measures go also the rewriting and reprinting of cook books.

More complex measures of capacity are found in gas and water meters and gasoline-measuring tanks. Such a few of these as have but one dial would be adapted to the new units by replacing the existing dials with new ones, mechanics from the factories going the rounds and making the substitutions. Most such devices have three or more dials, so interrelated as to necessitate their reconstruction by sending them to the factories in which case a substitute instrument must be supplied while the change is being made or sales of gasoline and the use of gas and water be discontinued during this interval. The inconvenience of this would be so great that in many cases new instruments would be installed to save delay and loss of business. Wholesale and retail price lists would have to be changed and reprinted.

MEASURES AND WEIGHTS.

Of these there is a great variety. With the older even-balance scales the only change required would be the weights. Many modern even-balance scales, however, use weights for even pounds only, a graduated beam being fitted for fractions of pounds or ounces. Such scales would require the same changes as platform scales below.

The metric party have frequently claimed that platform scales could be changed by regraduating their beams, but this is impossible because they are

not long enough. A beam graduated to 100 pounds will hold graduations up to 46 kilograms only and 46 kilograms are a hopeless base on which to build up a set of supplementary multiple weights.

The only practicable ending of the beam graduations is 50 kilograms and, to get these on beams to go into the places vacated by the old ones, would require changed ratios between their long and short arms, these to be calculated after precision measurements of the old ones. These measurements would require the old beams to be sent to the factory and, during their absence, the use of the scales must be suspended or substitute scales must be provided.

The larger platform scales are highly specialized. Among these may be mentioned sunken warehouse and railroad track scales which are fixed in place and not portable as in the case of smaller scales. They must be altered in the same manner as the smaller scales and, a substitute scale being impossible, warehouses must suspend weighing incoming and outgoing merchandise, and railroads must suspend weighing freight (that is, suspend shipments) while the alterations are being made.

Of small platform scales we have also the newer types of dial and computing scales. The former need only be fitted with new dials for which they might be sent to the factories or mechanics from the factories might go the rounds and change the dials. Computing scales would require reconstruction, for which they must be sent to the factories. During their absence substitute scales must be provided or business be suspended.

Of still another type are the automatic scales used in elevators for weighing grain in bulk. These would require reconstruction of their registering and recording apparatus and suspension of operations while the work is being done.

All prices from producer to consumer would have to be changed.

MEASURES OF LENGTH.

No measure of length in metric units can be made with instruments reading in English units, and the adoption of the metric system involves the scrapping of all such instruments, many of which are of a refined and expensive character. Some of these instruments are used only in manufacture, but, as a witness has said, page 6 of the record, that the cost of the adoption of the system by manufacturers will be "so small that, like ourselves, they will never be able to find the cost," they are appropriately listed here. They include ordinary scales, micrometers, verniers, height and depth gauges, and dial-reading instruments. Measuring machines must be reconstructed and their use suspended during reconstruction. The modern Swedish and Hoke gauges to English sizes become useless and must be discarded and metric gauges substituted.

All sawmills are fitted with set works giving thicknesses of boards and sizes of timbers in inches. These must be reconstructed or replaced.

Signposts on highways giving distances to near-by towns in miles must be changed to read in kilometers. Automobile speedometers, both for indicating speeds and recording distances must be reconstructed or replaced with new ones. Mileposts on railroads must be changed to read in kilometers, relocated, and new ones provided to meet the fact that the kilometer is one-third shorter than the mile. Railroad passenger and freight rates must be revised in metric units and new books of rates written and printed. The equivalent rates being usually fractional, they must be revised to round figures. If revised upward, the Interstate Commerce Commission will object, and the shipper will lose; if revised downward, the railroad companies will lose and object. New mileages must be calculated for time-tables and books of rules be rewritten and reprinted with speeds in kilometers instead of miles.

All prices from producer to consumer must be changed and, in the case of textile goods, the machines by which they are folded. Clothing of all kinds to be made to new units, and the entire population must learn anew the sizes of all articles they wear.

When these changes have been made, we will continue to pay the same amount of money as before for the same quantities of goods. The only change will be in calculating the cost of the goods in new and strange units. No benefit due to this change has ever been shown.

THE METRIC EQUIVALENT SCHEME.

On page 5 of the record Mr. Miller testified, "We change nothing * * * We just express them in another manner." His suggestion that we make

no change in existing standard sizes, but keep them as they are and measure them in metric units, has followed the demonstration of the prohibitive cost of changing these sizes which before that demonstration the metric party had ignored.

Some examples are here given:

An 8 by 10 inch pane of glass becomes a 203 by 254 millimeter pane.
A 10 by 12 inch stick of timber becomes a 254 by 305 millimeter stick.
A 3-inch plank becomes a 76-millimeter plank.
A 6-inch pipe becomes a 152-millimeter pipe.
A 120-inch wheel base (automobile) becomes a 305-centimeter wheel base.
A 32 by 4 inch automobile tire becomes a 814 by 102 millimeter tire.
A 2¼ by 4 by 8¼ inch brick becomes a 57 by 102 by 210 millimeter brick.
A three-quarter inch garden hose becomes a 19-millimeter hose.
A No. 7 hat becomes a 178-millimeter hat.
A 16-inch collar becomes a 406-millimeter collar.

Let there be no misunderstanding. The retention of existing sizes and their measurement in metric units is advocated, and the examples given are but a few illustrations. That the new figures are an improvement on the old is preposterous. It is of course clear that a metric enthusiast may use this plan for the specialty of his daily life, but that the general public will adopt them for the general domestic and trade activities is unthinkable, and the only choice the public will have is between the use of these equivalents and the retention of the English units for all standardized sizes and things.

Impossible as these figures appear, it is only when English sizes and their metric equivalents are arranged in series that the hopelessness of the adoption of the latter by the general public is fully apparent, as we then see how simple round figures that can not be forgotten become a tangle of decimals that no one can remember. In the accompanying table are shown some things that we are asked to adopt as the first step in the process of simplifying our weights and measures:

	Millimeters.
1 inch	25.4
2 inches	50.8
3 inches	76.2
4 inches	101.6
5 inches	127.0
6 inches	152.4
7 inches	177.8
8 inches	203.2
9 inches	228.6
10 inches	254.0

	Square centimeters.
1 square inch	6.452
2 square inches	12.903
3 square inches	19.355
4 square inches	25.807
5 square inches	32.258
6 square inches	38.710
7 square inches	45.161
8 square inches	51.613
9 square inches	58.065
10 square inches	64.520

	Meters.
1 foot	0.3048
2 feet	.6096
3 feet	.9144
4 feet	1.2192
5 feet	1.5240
6 feet	1.8288
7 feet	2.1336
8 feet	2.4384
9 feet	2.7432
10 feet	3.0480
1 yard	.9144
2 yards	1.8288
3 yards	2.7432
4 yards	3.6576
5 yards	4.5720
6 yards	5.4864
7 yards	6.4008
8 yards	7.3152
9 yards	8.2296
10 yards	9.1440

	Square meters.
1 square foot	0.0929
2 square feet	.1858
3 square feet	.2787
4 square feet	.3716
5 square feet	.4645
6 square feet	.5574
7 square feet	.6503
8 square feet	.7432
9 square feet	.8461
10 square feet	.9290
1 square yard	.8361
2 square yards	1.6723
3 square yards	2.5084
4 square yards	3.3445
5 square yards	4.1807
6 square yards	5.0167
7 square yards	5.8529
8 square yards	6.6890
9 square yards	7.5252
10 square yards	8.3610

No claim is made to any improvement in the product, and, indeed, there being no physical change there can be no improvement. The only change is the

substitution of the metric for the English figures, because, as the witness claims, the metric are "more simple and less liable to error than the English." Comparison of the two sets of figures will show that the claim is not well founded.

The Bureau of Standards has published a pamphlet (Circular No. 47 on Units of Weights and Measures) containing 45 pages of similar conversion factors, for the director of the bureau as well as the secretary of the American Metric Association has indorsed the plan of which the absurdity is here set forth.

The complications and delays growing out of the attempt to produce the 75 and 155 millimeter French guns during the Great War are explained in the statement of Col. Tschappat (pp. 109–113 of the record), and they fairly illustrate the nature of the problem as applied to the machine shop. They should, however, be read in relation to the advice given to the Secretary of War by the president of the American Metric Association as we entered the war that then was the time to adopt the metric system for all war purposes. Moreover, the time lost, when time was the most important thing on earth, should be contrasted with the statement published broadcast by the World Trade Club that the war was won because we adopted the metric system, as it was by such statements that it brought about the sending of 100,000 petitions for the adoption of the system to Washington.

LOCOMOTIVE BUILDING.

Mr. Vauclain tells us: "For instance, you never build the same locomotive over a second time. Nobody ever wants a locomotive the second time after it is first built." (See p. 154.)

This statement is a complete explanation of his experience. We have always freely admitted that many things may be made to the metric system without much difficulty. The difficulty lies not in introducing the metric, but in getting rid of the English system, and this difficulty is found not in such industries as Mr. Vauclain's, where "you never build the same locomotive over a second time," but in standardized manufacture.

It seems impossible to get the metric party to understand that while some changes are easy others are supremely difficult. Their logic is that since some changes are easy, therefore all are easy, whereas the facts show that all attempts to adopt the system have been but partial successes, and the complexities introduced by a partial success make it in effect worse than a complete failure.

INDEPENDENT USE.

A witness, Mr. Bearce, page 142 of the record, tells us that "no one manufacturer, no one industry, can do that (adopt the metric system). He is hedged about by the actions of his neighbors."

Unfortunately for Mr. Bearce, two examples have been placed before the committee in which the thing he says can not be done has been done. I refer, of course, to the testimony of two witnesses, Mr. Miller and Mr. Vauclain. All self-contained industries are in the same position, the actions of their neighbors presenting no obstacle. Examples of such self-contained industries are the manufacture of watches, clocks, typewriters, sewing machines, cameras, cash registers, adding machines, agricultural machinery, and musical instruments of all kinds, including phonographs. Every manufacturer of such products is perfectly free to adopt the system if he desires, and the fact that it makes no more progress in such fields than in others can only be due to the fact that it offers no advantage.

THE SAVING OF TIME IN PRIMARY EDUCATION.

A witness, Mr. Schieffelin (see p. 9 of the record), refers to a prominent educator who claims a saving of two years in the school life of every child due to the adoption of the metric system, and another witness, Mr. Haynes (p. 22 of the record), places the saving at "roughly a year and a half."

This claim is a standard one among metric advocates, but facts or data to confirm it are never given. It is an established phychological law that the mind accepts anything that is sufficiently repeated, and the more so if it appears to confirm what one desires to prove. The metric advocates have copied and

repeated this statement from one another so many times that, without evidence to support it, they have come to believe it.

In 1917 the American Institute of Weights and Measures investigated this subject through an analysis of the curriculum of the schools of New York City, which form the largest system of schools on earth in which a uniform plan of work is followed. The curriculum provides, term by term, maximum and minimum times to be devoted to all major subjects, and from it, by simple summation, the time given to each subject may be determined.

The investigation showed that the total or aggregate time devoted to the entire subject of arithmetic varies between 7.8 months for the brightest and 12.2 months for the dullest pupils, and, similarly, that the total time given to denominate numbers and weights and measures combined varies between 2.2 and 3.35 weeks.

Not all of even this modicum can be saved; as the division of the circle into degrees, minutes, and seconds, of the year into months, weeks, and days, and of the day into hours, minutes, and seconds would compel the teaching of those tables, while the subjects of interest and discount and of longitude and time will compel the teaching of denominate numbers.

Moreover, this bill provides for the continued use of the English units in industry. If they are to be used, they must be taught, the net result being that the teaching of the metric system will be added to the existing system; and time will be lost, not gained.

The results of this investigation were published in 1917, but the metric party have made no effort to refute them. On the contrary, they have ignored them and continued to repeat their old and disproven claim.

The details of the investigation will be placed before the committee if desired.

THE NUMEROUS WEIGHT BUSHELS.

The weight-bushel situation presented by Mr. Hubbard, secretary of the Bureau of Standards (see p. 44 of the record), and by Dr. H. W. Wiley (p. 121 of the record) will not be changed in the slightest by the adoption of the metric system. These weight bushels are due to the fact that different agricultural products are of different densities. Wheat, corn, and rye do not weigh the same per hectoliter any more than they do per bushel, and the adoption of the metric system would simply substitute a series of weight hectoliters which must be learned for weight bushels which those concerned now know. The simple and sufficient remedy for this condition, if it needs a remedy, is to sell all these products by the same unit of weight, such as the cental or hundredweight. As the chairman has pointed out, this is now done with some products.

Following are a few examples of the weight hectoliters which the adoption of the metric system would compel farmers and the grain trade to use:

	Pounds per bushel.	Kilograms per hectoliter.
Wheat, potatoes, alfalfa seed, peas, white beans, clover seed	60	77.23
Shelled corn, rye, flax seed	56	72.07
Barley	48	61.79
Oats	32	41.19

These figures give the erroneous impression that the weight bushels and the weight hectoliters do not greatly differ, due to the fact that a larger capacity measure is translated into a larger weight measure. As a matter of fact, the hectoliter is equal to 2.838 bushels.

Essentially the same answer applies to the chief argument of Mr. Arthur P. Williams (see p. 132 of the record), who tells us that "It will mean the elimination of thousands and thousands of sizes we use to-day, such sizes as the 6-ounce tin, the 6¼, the 7½, the 7¾; in the case of canned salmon the 8-ounce tin, 9-ounce, 10-ounce, 11-ounce." These sizes might be eliminated with the pound as a basis equally as well as with the kilogram. Mr. Williams adds: "We are being offered new sizes every morning." The passage of this bill can not affect this situation in the slightest.

THE USE OF OLD NAMES FOR NEW UNITS.

A witness, Mr. Howard Richards, jr., secretary of the American Metric Association (see p. 49 of record), gives the following quotation from Dr. William G. Wells, chief statistician of the Pan American Union:

"Scarcely a vestige of the old standards is left in any country that has adopted the metric system. Now and then in Latin-American countries one will hear the old words, but almost always with a meaning adapted to the new scale."

This is a standard claim of many metric advocates, and translated into examples it means that when the people of Latin America say "vara" they attach to it the value of the meter, and that when they say libra they attach to it the value of 500 grams.

In 1918 the American Institute of Weights and Measures conducted and investigation of the weights and measures of Latin America by means of a questionnaire, which, translated into Spanish and Portuguese, was distributed throughout Latin America. The distribution was effected through the cooperation of the National City Bank, the United Fruit Co., W. R. Grace & Co., and the Hill Publishing Co., all of whom sent the questionnaire to their correspondents in Latin America. The institute office also distributed copies to parties whose names and addresses were obtained chiefly from the United Fruit Co.

The result of this investigation was to show the continued wide use of the old Spanish system as well as the considerable use of the English system in every country of Latin America. In addition to direct replies to the questions asked, many gave additional information which disproves the claim of Dr. Wells. Following are a few quotations from the returned questionnaires:

"Same as in the United States." "English sizes." "For distance, the English mile." "English and metric system." "French and American indiscriminately.' "Thickness of lumber is always in English inches." "Metric system infrequently." "The two standards are used indiscriminately." "The meter is used very little." "The artisans of the country use in their calculations the Spanish vara as their standard." "Our standard of weight is the quintal of 100 Spanish pounds." "The people continue to use the old Spanish measures." "At retail, vara; at wholesale, yard, meter." "While the metric system is legal it is not enforced." "In domestic business, only the Spanish system is used." "A few French articles are in metric sizes." "The caudra is still commonly used, but is prohibited in the documents." "The English measures prevail." "Generally the English foot, exceptionally the meter." "The old Brazilian system is still commonly used." "Cloths are sold indiscriminately by meters, vara, and yards." "Occasionally the metric ton." "The metric measurements are sometimes used."

Such expressions as the above, of which there are many more, can not be explained in Mr. Wells's convenient manner.

Many of these reports give values of the Spanish in terms of metric and English units, which show that the old names are not used for the new units. Of these, a few of many examples follow (note that the libra is not a half kilogram):

From Costa Rica: Vara, 0.836 meter; libra, 460 grams; cuartillo, 4.165 liters; botella, 0.67 liter; manzana, 6,988 square meters.

From Argentina: Vara, 0.866 meter; pie, 0.289 meter; libra, 0.4594 kilogram; tonclada, 918.8 kilograms.

From Nicaragua: Vara, 33 inches; libra, 16 onzas; fanega, 288 libras; manzana, 10,000 square varas.

From Ecuador: Vara, 84 centimeters; libra, 16 onzas; cuadra, 100 square varas.

From Guatemala: Vara, 2.78 feet; manzana, 10,000 square varas; caballeria, 64 manzanas; cuadra, 625 square varas.

From Mexico: Vara, 2.7 feet; onza, 1.0148 ounces avoirdupois; cuartillo, 1.7 quarts; sitio, 1,755 hectares; caballeria, 42 hectares.

From Venezuela: Vara, 0.836 meter; pie, 0.279 meter; pulgada, 0.023 meter; libra, 460 grams; arroba, 11.5 kilograms.

From Honduras: Vara "about 33 inches"; manzana, "100 square English yards."

From Brazil: Libra, 0.45905 kilogram; arroba, 14.6896 kilograms; oitava, 3,586 grams; quartilho, 0.665 liter; canada 2,662 liters.

From Peru: Vara, 83 centimeters; topo, 5,000 square varas, or 3,485 square meters; quintal, 46 kilograms; marco, 228 grams.

From Chile: Quintal, 46 kilograms; arroba, 11½ kilograms; corcada (cord for wood), 6 pies by 3 pies by 3 pies.

More might be given to the point of weariness, but the above are sufficient. Not one of all the hundreds of sheets comprising the replies to the Latin-American questionnaire contains a single item to substantiate the theory advanced by Dr. Wells. No proof of it has ever been offered; it is clearly untenable and must be dismissed.

The result of this investigation, including the above quotations, was published in 1918 and there is no excuse for the repetition of this claim except failure to learn the facts.

IS THE METRIC SYSTEM BETTER THAN OTHERS?

While the hearings on the bill before your committee are particularly intended to bring out expressions on the bill itself and its effect on the population at large, many of the witnesses heard so far have insisted on presenting their claims for the abstract merits of the metric system. This reply to these claims is, therefore, offered, and, even though the committee may consider it not germane to the bill before it, I submit that it should go upon the record.

THE VERDICT OF FRANCE.

The clearest of all verdicts against the merits of the system for the purposes of every-day life comes from France, where it was originally promulgated by compulsory law in 1793. This law continued in force for 19 years, or until 1812 when, under Napoleon, who had no faith in the system, it was repealed, and the people were permitted to resume their old truly universal system in which 12 inches make a foot, 3 feet make a yard, and 16 ounces make a pound.

To distinguish by name this system from the metric system, it received the official title the système usuelle, and, while a book might be written on this reversion of the French people to their old measures, it could add nothing to the force of this title which, in two words, tells the whole story.

This système usuelle continued in use for 28 years or until 1840 when metric force laws were reimposed.

How are we to account for the reversion of the French people to their old measures as soon as they were given the opportunity? If the metric units are better than the old ones, are not 19 years of their enforced use sufficient to demonstrate the fact? Is it not clear that the French people reverted to their old measures because they found them better adapted to their purposes than the new? This is the only possible explanation and it is to be remembered that this is not the opinion of a few individuals, but the verdict of the nation.

As Herbert Spencer put it:

"For half a century after the metric system had been legally established the French did not discover its convenience. The alleged discovery of its convenience went along with the discovery that they would be punished if they did not use it."

What, however, are the results of the reimposition of the metric system in 1840? These results are summarized in an official communication by M. Gaston Doumergue, French minister of commerce, industry, and labor to local French chambers of commerce in 1906 of which the following are extracts in translation:

"My department at different times has been called upon to give to the department of weights and measures instructions for accomplishing the total suppression of the measures and weights prohibited by the old law of July 4, 1837, by the seizure of the prohibited articles. The department, in spite of all such efforts, has not succeeded in attaining the desired result. The situation appears to be due to the persistence with which certain trades continue to use the prohibited weights and measures.

"I have learned that in certain industries the advertisements, prospectuses, catalogues, etc., used by the merchants among themselves and also for sending to their customers contain the illegal expression. The merchants will invoke, without doubt, the necessity under which they find themselves not to change the existing order of things for fear that thereby they may lose orders for their goods. They thus continue to designate in lignes and inches all the articles they sell.

"I do not consider it worth while to enumerate here the industries and professions which have continued to employ the prescribed standards, but they are still numerous and most of them known to members of your organization."

The condition here officially admitted exists after more than a century of trial of the metric system, 70 years of it under compulsory law. How can it be explained if the metric system is better than the old one.

The letter concludes with an appeal to the chambers of commerce to use their influence to bring about a renunciation of this illegal practice. Along with this should go the following from the reply of the chamber of commerce at Amiens:

"The chamber considers that, in view of the customs adopted by certain traders, it seems difficult, if not impossible, to arrive at a complete suppression of the actual conditions; that, moreover, such a radical and immediate suppression would cause profound disturbance in many industries."

"Such a radical and immediate suppression would cause profound disturbance in many industries," and this at the end of 112 years of effort and of 70 years of compulsory law!

THE VERDICT OF LATIN AMERICA.

To the people of no other country has been given this opportunity to express their preference between the two systems after a trial of the new, but, nevertheless, the verdict of Latin America is unmistakable. The system was adopted in most of the Latin-American countries more than half a century ago—in the decade between 1850 and 1860—and to-day the people use it only to the extent that they are compelled by law.

In but one country—Uruguay—is it really adopted for domestic purchases and sales and this because of laws, which to us easy-going Anglo-Saxons, seem fairly grotesque, and, moreover, even those laws are but partially effective as, in spite of them, we find many exceptions.

Argentina and Venezuela also have drastic laws but they are not, apparently, so rigidly enforced, as in those countries we find a much larger use of the old measures. In all Latin-American countries the use of the system is in exact accord with the severity of the laws, and in most of them among the people it is used but little. In 10 of them it can scarcely be found in popular usage while in 5 the English units are used far more than the metric, although these 5, like the others, are, in metric literature, claimed to be purely metric. Half a century of tutelage ought to be enough to demonstrate the advantages of the system, if they exist, and is it not clear that the people of Latin America continue to use the old units because they find them better adapted to their purposes than the new ones?

These statements are based on the Latin-American questionnaire mentioned more at length under the subhead, "The use of old names for new units." The original signed questionnaires as returned from Latin America will be placed before the committee if desired.

The preference of the people of Latin America for the ancient system is not confined to usage in domestic purchases and sales. We have an accurate census of the machine tools in Latin American shops and factories which is a striking example of this preference.

For the benefit of the nontechnical reader it should be explained that machine tools are the machines with which machine shops are equipped. They are the foundation of modern mechanical industry, being the parents of all other machines of whatever kind and purpose since all parts of such machines are made thereon and on them every dimension of every part is determined. This is true even of the implements of war as the world has recently learned.

The census of machine tools in Latin America under prewar conditions shows that 39.3 per cent thereof were made in the United States and 43.2 per cent in Great Britain, a total of 82.5 per cent having been made to the English system, while the remaining 17.5 per cent were made in France, Belgium, and Germany and to the metric system.

In other words, Latin-American factories have shown their preference for machines made to English over those made to metric measures in the ratio of nearly 5 to 1.

THE VERDICT OF MECHANICAL INDUSTRY.

Next I wish to point out that while the system has been repeatedly adopted under high hopes by industries in the United States and Great Britain, it has not made good its promises.

Twenty years ago the Library Bureau was the star example of the progress of the system in this country. At the foundation of that industry the system was adopted for the manufacture of its products.

Nevertheless, after 30 years' use the system was abandoned by the Library Bureau, which now manufacturers its products to the English system. A similar example is found in Great Britain where, in the decade of the nineties, the Willans & Robinson Co., of Rugby, was organized for the production of the Willans high-speed engine, for which the metric system was adopted.

While continuing the system for the production of this engine, because of the difficulty of a change and the necessity of continuity of production, the system, was, after 20 years, abandoned for all new work, Willans & Robinson summarizing their experience in these words:

"We are satisfied that the adoption of the metric system has cost us a great deal in gauges and special tools without adequate return."

Similarly, the Ericsson Manufacturing Co. of Buffalo, N. Y., (manufacturers of the Berling magneto), report that while 10 years ago they used the system exclusively they have now abandoned it.

The pioneer American watch factory—The Waltham factory—adopted the system early in its history. The Waterbury (now the Ingersoll) works was established by men from the Waltham company, who carried the system with them, but beyond that the influence of the Waltham example has not gone, all other American watch factories following the English system. Similarly, the pioneer makers of steam boiler injectors (William Sellers & Co.) adopted the system for that product, but none of their competitors has followed their ex-example, all other makes of injectors being to the English system.

In the case of watches and injectors, would not the advantage of the system, if it had any, have led to its use by those who followed the pioneers, and is not the fact that they have not used it satisfactory proof that it has no such advantage? Moreover, William Sellers & Co., who adopted the system for this purpose about 1860 and thus have a longer experience with it than any other American manufacturer, now say:

"Our experience with the metric system, extending over 50 years, does not encourage us to extend its use beyond the borders of the shop and the class of work for which it was originally started."

Another example is found in the optical industry. When a quarter of a century ago the making of optical instruments received its great impetus in this country, it was found necessary to import skilled workmen from Europe for the grinding of the lenses. Those workmen had learned their calling in the metric system in which all their formulas and working data were embodied and they naturally continued to use the system here. It is, however, a striking fact that, except the lenses which, numerically, are a small part of the optical instruments, such instruments are made to the English system. We thus have two systems in use side by side in the same factories, and it is clear that if the metric system possessed the advantages claimed for it, those advantages would have led to its adoption for the remaining parts of optical instruments.

It is to be noted, moreover, that we are now discussing scientific apparatus which, although made chiefly to the English system, is accepted by scientific men as entirely satisfactory for their purposes. This being the case, by what right do these men claim that others will not accept machinery unless made to the metric system?

Still another case in which, after an initial trial, the system was not found to justify the effort found necessary to use it is found in the chemical industry of the Solvay Process Co. of which the drawings used in the construction of the first plant came from Belgium and were in the metric system. The Solvay Process Co. write:

"As the workmen in this country were not used to these measures, it became necessary to translate them into the foot and inch system. In many cases this was done by using 40 inches for the meter, which gave even inches. We have stuck to the foot and inch for measurements because it was too much of a task to educate all of our workmen to the other system."

THE VERDICT OF CHEMISTRY.

In 1917 the American Institute of Weights and Measures conducted an investigation of the extent to which the metric system is used in the production and sale of goods for export trade. Several thousand questionnaires were sent to a list of manufacturers supplied by the American Manufacturers' Export Association, and between 1,400 and 1,500 replies were received. Among them were replies from 21 manufacturers of chemicals, one reporting petroleum products and another pharmaceutical preparations, being so classed, which replies will be placed before the committee if desired. Of these manufacturers, one replied that, in the production of his goods, he used

the metric system "extensively"; one replied that he used the metric system "slightly"; and 19 replied that they used it "not at all," and this is my reply to the claim that the system is "universal" in chemistry.

Every chemical factory has, as part of its plant, a laboratory in which, according to Mr. Schieffelin and others, the metric system is exclusively used and its supposed advantages are constantly in evidence. Were these advantages real, is it conceivable that the use of the system would not extend from the laboratory to the factory?

I subscribe myself, with great respect,

FREDERICK A. HALSEY,
Author of "The Metric Fallacy."

The CHAIRMAN. Are there any other witnesses to be heard to-day?

Mr. STUTZ. Yes, sir.

The CHAIRMAN. You have given the committee some very valuable data in your presentation, and we are obliged to you. I am sure it will be helpful to us.

STATEMENT OF MR. SAMUEL L. NICHOLSON, ASSISTANT TO VICE PRESIDENT WESTINGHOUSE ELECTRIC MANUFACTURING CO.

The CHAIRMAN. State your full name and the position you occupy.

Mr. NICHOLSON. Samuel L. Nicholson, assistant to vice president Westinghouse Electric Manufacturing Co.

I have been asked to come here by our company in connection with this bill, in opposition to it, mainly on the ground that it is unworkable, you might say, for American manufacturers.

Taking the bill as it stands, there is nothing to prohibit us, as I see it, from manufacturing under any system of measurements we see fit, but the moment we come to sell goods or to transport goods then we are in violation of the law, if this becomes a law at the end of 10 years, which in reality forces all manufacturers to use the metric system.

That would be a decided hardship not only upon the manufacturers of this country but I believe it would also increase the prices considerably for some time to come of many manufactured goods, due to the excessive costs incident to changing over from our present system to the metric system.

We are naturally opposed to the adoption of such a bill and to the metric system. Take in our own case, we have probably over a million drawings, of which we are using probably 50 per cent almost all of the time; the remainder we will assume to be semiobsolete. Simply to change those drawings alone from feet to inches over to the metric system would cost us over a million dollars.

In connection, for instance, with repair parts, it would be a very serious matter. The obsolescence in our machinery is, at a minimum, probably about 20 years. We would have to carry on a double system for 20 years after the bill went into effect, and that would be almost impossible in a shop without confusion worse confounded.

In addition to that, all of our machinery, tools, and gauges are built to conform to the English system. To change them would mean an enormous expense. For instance, the obsolescence in some of our tools would cover a longer period than the 10 years allotted here.

So you can see from the manufacturing standpoint that it is highly undesirable, and we believe it would be extremely detrimental to the manufacturers of this country, not only in so far as their own manufacture is concerned but in relation to foreign trade.

We have found, in our foreign trade, that it is not detrimental to use the English system. On the contrary, in many instances it has been a benefit to us, rather than to use the metric system. The English system is accepted through the world, as a rule, because it is the system used by the largest manufacturing countries, with one or two exceptions, as you probably know. And I think we have to take that into consideration. It is a question of manufacture, and not a question of theory.

Weights, measures, and dimensions are largely used by manufacturers. When you come to talk about the chemical industry, it is a comparatively easy thing to transfer it over into the chemical industry, because you change a few bottles and weights and you are done. But when you are building machinery to last for all time it is another question altogether.

Those are the main points I had in mind. I do not want to take up your time. Mr. Stutz has testified, and I know you have before you the National Industrial Conference Board's analysis of the situation. But I simply wanted

to put in a strong objection to the bill from a manufacturer's standpoint, as strongly as we know how to put it in, without going any further into details.

The CHAIRMAN. Do you think the views you have expressed here obtain generally with manufacturers throughout the country?

Mr. NICHOLSON. I think that is so. There are one or two present in the room. I do not know whether you would care to hear from them.

The CHAIRMAN. As long as they are here, I think we should have their statements for the record.

STATEMENT OF MR. A. W. BERRESFORD, VICE PRESIDENT CUTLER-HAMMER MANUFACTURING CO., OF MILWAUKEE.

The CHAIRMAN. State your name and the position you occupy.

Mr. BERRESFORD. A. W. Berresford; vice president Cutler-Hammer Manufacturing Co., of Milwaukee.

Mr. Nicholson has spoken from the point of view of the large manufacturer, and from the point of view of the smaller manufacturer I want to speak and to thoroughly indorse what he has said. The same things that bother them would bother us.

Take, for instance one of our departments, our total machine-tool investment in that department is about $90,000. I happened to be looking over some records yesterday, where the special-tool investment for making the specific things that are produced in that department—gauges and so on—runs nearly $190,000. If we were obliged to manufacture, and manufacture conveniently, under the metric system, that $190,000 would be ultimately obsoleted without any question.

I want to indorse his statement as to the 10-year period being far too short, if this thing is ever consummated, although I can see no reason why it should be; but if it is ever made effective, the 10-year period is far too short for any turnover from the present existing satisfactory system.

The CHAIRMAN. What period would you suggest?

Mr. BERRESFORD. I can see no reason for doing it at all. But to comfortably turn over it would certainly require from 50 to 75 years. Then you would have a transition period of 25 or 30 years in which we would be using a double system, and a double system means four times the effort every time. I can see no advantage to be gained.

The CHAIRMAN. Is there any demand for it in the commercial world of which you know?

Mr. BERRESFORD. Take it right from the record. It has been a permissive system, a preferred system, in the United States for a great many years—for I do not know how long.

Mr. STUTZ. It has been permissive since 1866, and nothing has grown up in manufacturing that calls for it at all.

Mr. BERRESFORD. It is not used. Your engineer may use it some in his figuring, but that is purely a matter of using the decimal point instead of using the duo-decimal system in his figuring; that is all. But in manufacture itself it has not gone into use, and unless we are compelled to put it in it will not go into use.

That is practically all I have to say.

The CHAIRMAN. Thank you very much.

STATEMENT OF MR. FRANK B. JEWETT, VICE PRESIDENT AND CHIEF ENGINEER OF THE WESTERN ELECTRIC CO.

The CHAIRMAN. State your name, address, and the position you occupy.

Mr. JEWETT. Frank B. Jewett, chief engineer of the Western Electric Co., New York.

I did not come here to-day prepared to testify, but I have given this matter some thought, and I want to second both the remarks of Mr. Nicholson and Mr. Berresford with regard to the lack of demand for and the difficulties which would be encountered in any forced adoption of this metric system in any such period of time as this bill contemplates.

As you gentlemen probably know, the Western Electric Co. is and has been for many years the manufacturing organization of the Bell telephone system. Numerous times in the past we have ourselves considered the question of adopting the metric system in the telephone industry, where it would have been easy

for us, having control of the developing, manufacturing, and operating sides, to have affected it.

The reason that consideration has come up in times past is because electrical engineers in their electrical computations make them on the basis of the metric system. On the mechanical side, however, it is not used. Every time we have considered it we have come to the conclusion that there was nothing to be gained and much to be lost by any adoption of the metric system.

That is, it seems to me, particularly significant, because of the fact that we also maintain factories for telephone manufacture in many other countries of the world, many of which are on a metric basis, and we have never found any difficulty in competing in metric countries with English-made equipment—I mean equipment made according to the English standard.

In fact, there are many advantages, because America is looked to as the foremost country in the telephone art, so that American-made apparatus is at a premium in foreign countries; and we would consider that it would be disadvantageous in our foreign business to go on the metric system rather than advantageous.

Mr. Nicholson or Mr. Berresford mentioned the question of the cost of the changes. Not knowing that I was coming here, I have made no preparation with regard to estimating the cost in making the changes in our business, but they would certainly run as great, if not greater, than those Mr. Nicholson mentioned for the Westinghouse Co., because of the enormous intricacy of the telephone business.

As somebody has mentioned, it has been, as I understand it, permissive for many years to use the metric system, perfectly legal for people to use it; and the fact that no greater use has been made of that privilege would seem to indicate that there was no pressing demand for a forced adoption of the metric system.

When it comes to the question of this 10-year period, I have some rather definite ideas, if it should become desirable to make a mandatory change, and they are these: In the first place, the transition period, or the period before which the mandatory change should come into effect, should be long enough so that in the normal obsolescence of material the great bulk of the apparatus and machinery which was in existence at the time the law went into effect should normally have become obsolete and gone on the junk heap.

Ten years is too short a period for many industries; certainly too short for the telephone industry. The normal life which we figure for the major part of a telephone plant is at least 15 years; much of it is longer than that. The ordinary telephone central office is figured on a 15-year basis. Many of them are in existence longer periods than that.

Further than that, there seems to be a very large educational problem involved in any such change as this bill contemplates. I presume all of us have had some drilling in the metric system in our school days, and yet I venture to say that the great bulk of children who are trained in the public schools when they have grown to manhood know very little about the metric system.

So it seems to me that you would have to set a long enough period from the educational standpoint to thoroughly indoctrinate a large part of your population in a real knowledge of the metric system before you brought it into mandatory effect, and you would have to have a sufficient number of people trained and of a sufficient age so that they themselves would be the ones that would be really running the industries and manufacturing concerns at the time that the thing became manadatory.

Therefore, any such period as 10 years is, it seems to me, absolutely too short a time even though you should decide you do want to make a mandatory change and bring the metric system into effect at some definite date in the future.

I think, Mr. Chairman, that is all I have to say, unless you have some questions to ask.

The CHAIRMAN. Thank you very greatly. Mr. Nicholson, are there any other manufacturers here?

Mr. NICHOLSON. No; I think not.

The CHAIRMAN. We are very much indebted to you all for your testimony.

Mr. WILSON. Mr. Chairman, we have no more witnesses for to-day; we have for to-morrow and the next day. We hope to complete our presentation by Friday.

The CHAIRMAN. Then we will adjourn until 10.30 to-morrow morning.

(Whereupon, at 12 o'clock noon, the subcommittee adjourned until to-morrow, Thursday, December 15, 1921, at 10.30 o'clock a. m.)

THE METRIC SYSTEM.

THURSDAY, DECEMBER 15, 1921.

UNITED STATES SENATE.
SUBCOMMITTEE OF THE COMMITTEE ON MANUFACTURES,
Washington, D. C.

The subcommittee met, pursuant to the adjournment, in the committee room, Capitol, at 10.30 o'clock a. m., Senator Charles L. McNary (chairman) presiding.

STATEMENT OF MR. JAMES PARTINGTON, ESTIMATING ENGINEER, AMERICAN LOCOMOTIVE CO., NEW YORK CITY.

The CHAIRMAN. State your name, address, and the position you occupy.

Mr. PARTINGTON. James Partington; estimating engineer, American Locomotive Co., New York City.

I have read the bill and some of the testimony which has been offered, and I will say on behalf of the American Locomotive Co. that we can see no advantage in the passage of this bill. We do not believe it would be of any advantage to us whatever in the export trade, because we are not losing any business on account of the metric system. We are taking and accepting orders for locomotives to be built to the metric system if our purchasers so require, but have never lost an order on account of metric requirements.

The first order of locomotives built by the American Locomotive Co. to the metric system throughout was for the Paris-Orleans Railway in 1908. I was the engineer in charge of this work at Schnectady, N. Y., at that time. Taking up this job to the metric system was the cause at that time of considerable delay in putting the work into the shop and having the work executed in the shop, because we had to put the metric measurements into English equivalents, and to get our own engineers and the workmen in the shops familiarized with metric measurements.

If, as is probably the intent of this bill, it is desired or contemplated eventually to make the metric system the working system of all industries in this country, any industry which does not now use the metric system would experience a like delay, inconvenience, and expense in taking up the metric system, because it is like introducing a foreign language to engineers and workmen who are not accustomed to that system.

I have noticed in the testimony given that the claim is made that a person of ordinary intelligence can be made familiar with the metric system in 30 minutes. On the engineering side I would take serious objection to that statement and say that probably for many years engineers in this country would think in English weights and measures, and that a long period of time would be required before they could think in the metric system.

We have found in putting through drawings, which we have done a number of times as occasion demanded, that even after our men became accustomed to the metric system of measurement that system is more cumbersome than our own English system of measures.

For example, there are many calculations that can be made mentally and quickly by English measurement which, put into metric equivalents, require a calculation on paper. We may have a measurement of 852 millimeters and another of 1.048 millimeters. We set those down and add them to get the result. If, on the other hand, we had 34 inches and 42 inches, we mentally and quickly say 76 inches total.

In the execution of drawings the metric system requires in a similar manner more figures than the English system. I believe it is conceded by all engineers that engineering work in this country is done more rapidly than engineering work of a similar nature is done in foreign countries. I think this is

due to some extent to the greater facility of our system of measures, in that we have available the binary system of fractions as well as the decimal system, and it is frequently more convenient and quicker to use the binary than the decimal system.

If the manufacturing interests were changed to the metric system, the vast amount of engineering tables, formulæ, and data now in existence would have to be changed over to metric equivalents. This would entail a great amount of work.

For example, in the locomotive industry we have tables of standards carefully worked out for many of the important dimensions of locomotives. We have tables of boiler and engine efficiency based on horsepower, on evaporation, on fuel consumption, and like considerations, which would all have to be changed over to the metric system.

If the metric system was introduced into the shop, a great amount of change would be necessary, entailing large expense for changing over. Take, as an example, one of the smaller things in locomotive work, the question of bolts and nuts. The metric system of screw threads is based on even diameters in millimeters and pitch of threads in millimeters, which makes it entirely a decimal system and therefore entirely at variance with the English system of varying by one-eighth or one-quarter of an inch and threads so many per inch—for instance, 8 threads per inch or 12 threads per inch—so that we immediately have a striking difference.

The metric system of screw threads has not been fully adopted in any country which now uses the metric system. In 1915, when the American Locomotive Co. was building locomotives for the Greek Government, which were specified to have metric threads, I found it necessary to make an investigation with a view to determining whether a standard system of metric pipe threads was in existence. I found that no standard has been adopted for metric pipe threads, and that to-day in metric countries they are using either United States pipe threads or Whitworth pipe threads or, in some cases, a mongrel system of pipe threads which has nothing more than local warrant.

The latest German textbook available at that time, which was published in 1914, indicated that in Germany, for small pipes where they employed screw connections, they were using as their standard practice English Whitworth pipe threads.

In connection with locomotives the question of gauge may be cited. The English gauge of 4 feet 8½ inches is standard in practically all important countries of the world; and the only metric gauge employed, which is used to some extent in countries having the metric system, is for narrow-gauged locomotives, for which the railroads are constructed to meter gauge. The mileage of meter-gauged railroads in those countries and in the world is comparatively insignificant.

In South American countries the prevailing gauge is the United States standard, 4 feet 8½ inches, and they have, in addition, some lines built to 5 feet 3 inches gauge. In Russia their standard gauge is 5 feet, from which you will see that the metric system has been adopted to a very slight degree, indeed, in connection with the gauge of railroads.

Having had a very considerable experience in building locomotives to the metric system and, we believe, the opportunity to fully consider the question, we see no advantage whatever in a change to the metric system. If such a change was extended to the actual work in the shop and all the shop measurements were changed over to the metric system, we see a very decided disadvantage, in that the output of the shop for a considerable length of time would be seriously reduced and the expenses of operation would be materially increased.

The CHAIRMAN. Mr. Partington, would you care to make an estimate as to the amount of loss the company would sustain by reason of changing over to the metric system? Have you those figures?

Mr. PARTINGTON. I have no figures, Mr. Chairman. An estimate of that sort would necessarily be rather vague. I would, however, consider a million dollars a very conservative figure as representing what it would cost the American Locomotive Co. to change its shop practice to the metric system.

The CHAIRMAN. Under the terms of this bill the period of transition is given as 10 years. Assuming, for the purposes of this question, that Congress might agree to the passage of this bill, do you think that that period is long enough?

Mr. PARTINGTON. Ten years' time would be amply sufficient to make a change. The time period would have a bearing mainly in this way, that it would permit

the industries involved to spread the expense they would have to incur over a longer or shorter period, as the length of time may be fixed.

The CHAIRMAN. The committee is obliged to you, Mr. Partington, for your excellent statement. It will be very helpful when the committee read the record.

Mr. PARTINGTON. I might add this in connection with the question of calculations: I am a member of the boiler code committee of the American Society of Mechanical Engineers, which has recently completed and published a locomotive boiler code. This is a safety code which covers in a very complete way the construction of locomotive boilers. In that code we have some tables—in inches, of course—which carry the fractional part of the inch out in the decimal system, which shows that the decimal system can be applied just as readily to English measurements as to metric measurements if the necessity for decimal equivalents exists.

I might further cite the Federal valuation of railroads, which is now under way. This has involved up to the present time a very great expense, both to the Government and to the railroads. These valuation figures are, of course, in the English system of weights and measures. If the metric system were adopted, I presume that these valuation figures would have to be changed over to the metric system, which would involve a very large amount of additional work.

This is simply an example of one of the things in a large way which would be affected simply from the standpoint of valuation and accounting, aside from the manufacturing expense.

The CHAIRMAN. We thank you.

STATEMENT OF MR. W. DE S. TRENHOLM, SECRETARY RETAIL DRY GOODS ASSOCIATION AT NEW YORK CITY.

The CHAIRMAN. State your name, address, and occupation.

Mr. TRENHOLM. W. de S. Trenholm, secretary of the Retail Dry Goods Association at New York City. I am here in behalf of the members of that association, which embraces practically all of the large retail dry-goods stores in New York City.

The proposed change from the present English system of conducting business to the metric system involves more serious consequences to the retailer than it does to anyone else in any other line of business, because their business necessarily involves innumerable transactions. The bill provides that no one shall sell, attempt to sell, or offer to sell goods, wares, and merchandise except by the metric system. As I interpret that language, it would mean that when patrons came to the stores to make purchases the transaction must not occur unless it occurs under this system.

That involves the most difficult thing of all, of educating the public to the use of that system. You can not make anyone come into your store and offer to buy a fraction of a piece of merchandise and specify the dimensions in the metric system. For instance, a woman wants to buy a fraction of a yard of very expensive velvet which she desires to use in trimming a hat. She is accustomed to think in the present English system, and a quarter of a yard signifies something definite to her mind. If she has got to ask for that same quantity of merchandise by the metric system she necessarily must be familiar with those specifications.

You can readily see that in establishments such as the large retail stores in New York and elsewhere, where the employees run from 3,500 to as high as 7,000, you have got to educate the sales clerks so that when customers come in and ask for something by the old system which they are accustomed to employing, they will be able to translate promptly whatever expressions they use into the metric system and have the transaction conducted in that system according to the provisions of the law.

That is only from the standpoint of transactions which happen in the store in large numbers every day with the store patrons, but you have your accounting department, your inspection department, your shipping department, your delivery department, and that whole establishment has got to be reorganized in order to conduct the business according to this new system if the spirit and letter of the law are to be regarded. That is going to entail a tremendous complication and difficulty, as you can readily visualize.

These stores are crowded with people year in and year out. Approximately two-thirds, about 62 per cent, of the transactions that occur in the retail dry-goods stores are conducted under the present English system of weights and

measures. All of that will have to be modified, and the most difficult part—not the most expensive part but the most difficult part—is in educating the public to conduct their transactions by this new system. I think I am correct in my assumption that that is going to be an exceedingly difficult thing to do. It is going to be difficult not only to educate the public to make their proposed purchases on that scale but it is not going to be an easy thing at all to educate the sales force to translate one measurement into the other and conduct their transaction on this new system.

The CHAIRMAN. Of course, it would have to proceed on the theory that during the period of transition of 10 years mentioned in this bill the public would become educated by reason of the feeling of necessity, and that the goods, wares, and merchandise, at the end of that period, would all be placed in receptacles carrying the metric system of weights and measures. There would have to be the coordination of the buyer, the manufacturer, and the seller. This all occurs in that period.

Mr. TRENHOLM. I appreciate the fact, Senator, that the bill is generous enough in its provisions not to contemplate the immediate installment of such an arrangement, which, of course, would be impossible.

The CHAIRMAN. I was just propounding that proposition as being the letter and the spirit of the act in order to get your view as to whether or not that would be practicable in a period of 10 years. And, going beyond that, would it be met with good favor by the people generally, or would they rebel at the necessity?

Mr. TRENHOLM. Well, Senator, New York is different from any city in the Union. We have newspapers up there printed in several languages. It is not at all an uncommon thing to be walking along the street and hear people talking in foreign languages. Forty-nine per cent of the population, according to statistics, are foreigners. So that there may be a little more difficulty there, perhaps, than elsewhere. But it is going to be difficult in any institution of any size anywhere.

The CHAIRMAN. Are these foreigners accustomed to the metric system as a rule?

Mr. TRENHOLM. No, sir.

The CHAIRMAN. They are not?

Mr. TRENHOLM. No, sir; they are not. The transactions that occur with them to-day are accomplished with abundant difficulty, even under existing conditions. But if this metric system is injected into the transactions it is difficult to picture what a chaotic condition is certain to result.

And the bill is so specific in its provisions that they must not even offer the merchandise must not even be offered for sale according to the present system. It says you must not offer for sale or sell.

Briefly, what I have stated is the basis of our objections to the measure.

The CHAIRMAN. Let me ask you this theoretical question: Assuming that no hardships or inconvenience would be suffered by changing from one system to the other, would any good be accomplished that you can see?

Mr. TRENHOLM. Senator, I am very glad you asked me that question, and I would like to answer it in this way: During the war it was very gratifying to me to observe the manifestations of the patriotic disposition of the men and women with whom I have had the good fortune to be associated in business and their unhesitating willingness to cooperate in any measure that was for the good of the country as a whole. And I think I am safe in saying that their disposition is such that they would be willing to carry their share of a burden that for the greater number of the whole people might be beneficial. But I can not conceive that the good to be derived from the passage of this bill would in any way approximate the detrimental consequences that would result to business as a whole if this metric system is substituted for the present system.

To the stores it is going to be a special hardship, because their business consists of a multiplicity of transactions, and there certainly is going to result all sorts of complications and difficulties. I do not see how it is going to be possible to cause the public to go to the stores to buy and specify their wants in a system which is new to them, and with which it will take a long time to familiarize them, and which I believe some of them will never learn.

The uneducated people will have great difficulty in grasping the significance of the different expressions employed in the metric system.

That is just a brief idea, Senator, of the experience we believe we are going to have in the stores if this bill becomes a law.

The CHAIRMAN. It is full of meat, if it is brief.

Mr. TRENHOLM. It is really, sir, going to entail untold complications and difficulties in the conduct of the business, which is already fraught with innumerable difficulties. It was a revelation to me. I was, for some years previously, identified with the Steel Corporation, and within the last five years have been affiliated with these enormous enterprises, and no one outside of those organizations has any idea whatever of the questions that would, apparently, be irrelevant to the business, but which arise in its conduct, and of the innumerable difficulties with which they have to contend.

It is a very difficult thing to satisfy the public as a whole. It is impossible to do it 100 per cent, but even with the disposition to bend over backwards in an effort to please people who perhaps are not always reasonable they have tremendous troubles.

If this bill becomes a law I think the consequences of it are going to be more severe on the retailer, because of the nature of his business, than they will be upon any other line of business activity.

I know your time is valuable, sir, and I just wanted an opportunity to say this to you briefly.

The CHAIRMAN. I thank you. It brings into the record a new thought and a new discussion. So far as I am aware, we have not had thus far before the committee a representative of the retail merchants, and what you have said is very interesting.

Mr. TRENHOLM. Take in the case of shirt waists. There are waists that measure 36, 38, and 40 inches, and so on. A woman goes into the store and says, "I want a 36 waist." The expression is as familiar to most anyone who knows nothing about the industry as a dime or a nickel is to a person who handles money. If she wants to buy that waist under this new system, she has to go to the store and say, "I want a waist 914.4 millimeters."

You are going to have a very difficult time in educating people to use those expressions, not only in that instance but in other instances where they buy on that basis. You know yourself that if you were required to go to a store and ask for a garment by an entirely different method from that to which you have been accustomed you would have to give some little thought to it before you could know how to express your wishes.

The CHAIRMAN. I realize that.

Mr. TRENHOLM. Imagine what that would mean to the uneducated people who flock to the stores in large numbers. I just wanted to present that side of the situation and invite it to your attention, because the hardship of the proposition is going to be visited upon the retailer, and I think some consideration should be given to that. People who have no regular business occupation have at least the business experience of buying, and this bill is going to affect a tremendously large number of people in that way.

I thank you for the opportunity to explain the situation, and I hope I have thrown a little light on the situation.

The CHAIRMAN. Indeed, you have, and I am very thankful to you.

STATEMENT OF MR. E. C. PECK, REPRESENTING CLEVELAND TWIST DRILL CO.

The CHAIRMAN. State your name and occupation.

Mr. PECK. E. C. Peck, representing the Cleveland (Ohio) Twist Drill Co.

The CHAIRMAN. Have you a brief to present, or do you desire to make an oral statement ?

Mr. PECK. I would like to do both.

The CHAIRMAN. Very well; but I will ask you not to duplicate. We would not care to have you state in your oral remarks what you have set out in a prepared brief, and thus going over the same ground twice.

Mr. PECK. No; I have no desire to duplicate. One thing that I would like to mention orally is that this is not the only connection I have in life. I am a practical farmer in the way that I own and operate two dairy farms for profit. That is in my brief, but I thought that my connections and what I have been engaged in might cause you to ask some questions which would not be in the record.

I also had charge, as the chief, of a section in the Army during the late war that had more to do with measurements than any other, and I therefore know the effect that resulted to American industries of trying to introduce the metric system during the war.

I was also acting chairman of the National Screw Thread Commission, a commission appointed by the Government to go abroad and investigate conditions there. Therefore, I know what is the comparison between the metric threads and the United States standard.

With that sort of introduction as to what I am qualified to talk about, I would be glad to answer any questions you care to ask me.

The CHAIRMAN. Have you gone thoroughly into this system which is proposed by Senate bill No. 2267?

Mr. PECK. I worked with it 30 years.

The CHAIRMAN. With the metric system?

Mr. PECK. Both the metric and the English.

The CHAIRMAN. Have you looked at the provisions of this bill?

Mr. PECK. I have.

The CHAIRMAN. Do you think that the period of transition of 10 years is ample should this bill become a law?

Mr. PECK. I do not think you can educate the workingmen and the people to operate under this system in 10 years or in less than two generations.

The CHAIRMAN. As a farmer engaged in the dairy business, do you know of any practical demand for this law? On the other hand, would it work a great hardship, in your opinion, upon the farming class generally?

Mr. PECK. Undoubtedly it would work a hardship. The farmer can not think in metric terms, and he is not educated scientifically enough to translate. He would have to have big tables on the wall to do it with. He would have to throw away all of his scales and measures. He could use them on his own farm, if he wanted to, but he could not use them to sell anything with.

The CHAIRMAN. Would any advantages accrue to the farmer by reason of the adoption of the metric system?

Mr. PECK. Absolutely none.

The CHAIRMAN. You can not conceive of any?

Mr. PECK. I can not conceive of a thing.

The CHAIRMAN. You think it would result in hardship and additional expense to the farmer, do you?

Mr. PECK. Positively. For instance, every dairy farmer in these days who is up to date carries a large amount of records of his animals and the ancestors of the animals in order to know the value of his own stock. These records would be absolutely useless, and he would have to educate himself over again to have any idea of the worth of his animals.

A dairy cow is rated on pounds of milk and pounds of butter fat per year for a given amount of feed, which is all expressed in pounds.

The CHAIRMAN. That is, the feed and the product are expressed in pounds?

Mr. PECK. Yes. One farmer or one dairyman talks to another in that language. He has a cow that produced 500 pounds of fat, and she is a good cow. It is going to take years before one farmer can talk to another as to what that same cow would do in the metric system. The fact of the matter is that the entire dairy records of the farmer would have to be rewritten or reprinted at a big expense.

You can go further and find the same difficulty when that same animal is sold in terms of pounds. I have noticed in some of the testimony that the farmer is now bothered to death with various kinds of bushels in use. That was a new one to me, because I do not buy by the bushel. Practically everything I buy is bought in hundred-pound lots. Nearly everything I sell from the farm is sold in hundred-pound lots, and the daily papers, at least in our part of the country, give the quotations in hundred-pound lots.

Senator, some of these things will appear in my brief, but perhaps not drawn out as much as they are here. I have just touched upon them.

The CHAIRMAN. Let me see your brief. It appears to be a very interesting and comprehensive statement. Is there any other statement you desire to make in addition to what you have said?

Mr. PECK. No; except this. My whole life has been spent in manufacturing, and while I am here particularly to represent the Cleveland Twist Drill Co., I know manufacturing in practically all its details as regards small machine tools, etc.

The CHAIRMAN. Would the cost to your company, incident to the change, be very considerable?

Mr. PECK. You will find a detailed record of that in my brief. That is, I have a summary of a detail record, the exact details of which can be furnished on application.

The CHAIRMAN. Yes; I see you have it worked out here in great detail. What would apply in your manufacturing plant I assume would apply in others similar in character?

Mr. PECK. Yes; other plants that make or sell small articles that are built in large quantities and carried in stock.

The CHAIRMAN. Do you know of any particular advantage to the manufacturer that the change would bring about?

Mr. PECK. To the manufacturer?

The CHAIRMAN. Yes.

Mr. PECK. I think it would in the chemical laboratory of a manufacturing establishment.

The CHAIRMAN. Have they any difficulty in using that now in a voluntary way?

Mr. PECK. They do use it, and then transfer over for the factory.

The CHAIRMAN. Is that a practical thing to do?

Mr. PECK. Yes. The chemical industry seem to have built themselves up on the metric system. Metric has been legal, you know, for years. We claim that is all it needs to be now.

The CHAIRMAN. But you do not want it made compulsory?

Mr. PECK. That is it; we do not want it made compulsory, any more than we want a law passed that we can not sell for English money or French money or any other thing.

The CHAIRMAN. You think if it is needed by commerce it will finally make its way to the front and overthrow the English system?

Mr. PECK. It has always been my experience, Senator, that all the good things of this world come to the top of their own accord; you can not hold them down. The fact that this has been legal in this country for so long, and has not progressed further, indicates to me that it has its drawbacks.

The CHAIRMAN. Let me ask you this general question: Among your associates in the manufacturing industry and in dairying, and among people generally whom you know, have you heard any demand for the change?

Mr. PECK. To the metric?

The CHAIRMAN. Yes.

Mr. PECK. No. I have heard a great deal of opposition to it.

The CHAIRMAN. Does there seem to be general opposition to the change among those whom you know?

Mr. PECK. Yes; there seems to be of the people who use the actual physical dimensions and the actual, physical parts built to dimensions. I have friends who are greatly in favor of the metric system, but they are people that earn their living with paper and pencil, and I can see their side of it.

I am an engineer as well as a manufacturer, and I see no objection to using the metric on paper for my calculations, where I am using foreign units or am going to get into the metric system, but for the engineering work in this country I do not find it necessary. In fact, I use the decimal system in our own units and have for years, and the decimal system in our present units gives me every advantage that the decimal system in any other does.

The CHAIRMAN. That is about your statement, is it, Mr. Peck?

Mr. PECK. Yes, sir.

The CHAIRMAN. It is very complete, with the written statement you have presented, and I am sure we will enjoy reading it.

(The brief of Mr. Peck, heretofore referred to, is here printed in full, as follows:)

BRIEF OF THE CLEVELAND TWIST DRILL CO.

[Represented by E. C. Peck.]

CLEVELAND, OHIO, *December 12, 1921.*

1. The Cleveland Twist Drill Co. is opposed to the passage of S. 2267, believing it to be unnecessary and a hardship on the industries of the United States. This company, of which I am general superintendent or works

manager, and which I represent, manufactures twist drills, reamers, and the necessary adjuncts, and has made these tools in millimeter sizes for years. I have had a manufacturing experience in both the English and metric system of measurements for 30 years, and therefore am familiar with it from both a practical and an engineering standpoint. Besides this experience I was chief of the gage section of the Ordnance Department of the Army during the late war. This section had more to do with measurements and encountered more of the difficulties due to the metric system than any other department of the Army.

2. Before going into the details of my objections I will state a few fundamentals which, if kept in mind, will make my later statements more clear:

First. I believe thoroughly in standardization, provided it is for the purpose of interchangeability or provided the use of the standards set up affects an over-all economy in the conduct of the business of the world.

Second. Standardization should be of universal benefit and not unduly penalize a very large part of the whole.

Third. I differentiate between a decimal system and the metric system.

3. The first objection to the bill is that it will cause endless confusion in the industries for an extended period. It seems to indicate in section 2 that immediately upon its passage, the metric standards now at the Bureau of Standards become the primary standards from which all others are derived, but that punishment for failing to adopt them begins 10 years from that date. The result will be the immediate adoption of this new standard by some industries, whereas others will not adopt it until the last minute. The whole manufacturing public will be without a consistent standard for 10 years.

4. The second objection is that it gives a cabinet officer, Secretary of Commerce, who changes every four years, too much power by empowering him to make and promulgate the rules and regulations for the enforcement of the provisions of this act. It is, of course, true that the courts would finally pass upon these matters, but his power to make preliminary definitions as to what constitutes "goods, wares, and merchandise" puts into one man's hands the power to work disastrous hardships upon individuals and corporations, especially the former, who are usually unable to protect themselves against the acts of a powerful Government bureau. With a Secretary of Commerce favorable to the metric system, this would result in a ruling that farm products, real estate, land, etc., would have to be sold in metric terms. Such a ruling would soon set up an enormous number of agencies all over the country to translate the county land records into metric units, and would be accompanied by lawsuits due to mistakes, etc. It would, at least, result in a fee being charged to every seller or purchaser of land for making a legal translation of the present land measure. From this it would be only a step to a licensed body of mathematicians charging fat fees for translating values for farmers and laymen, who are not qualified to translate and who will fear either being cheated at every turn or defending a law suit for selling short measure.

5. At this point I may say that I am a practical farmer, owning and operating two dairy farms. I personally superintend the working of these farms and I do so for the purpose of earning a profit therefrom. They are not in the class ordinarily known as "country estates." I know from this experience and from my daily contact with my neighbors what hardships the passage of this bill will cause. Every measure and weighing scale of any kind must be changed. The habits of thought of men not primarily interested in chemical or astronomical calculations will be thrown into confusion about things of their everyday life. To ask a farm laborer to change his ideas of quarts and gallons into liters, his pounds into kilograms, to remember that his one-half inch bolt is 12.7 millimeters, is to ask the impossible, for one generation at least, and to cause endless confusion and expense to every farmer in the meantime.

I have a set of detailed farm costs and records covering an operating period of 10 years in which all values would have to be translated before I could make proper comparisons with records made by the system proposed by this bill. I keep feed and production records on the cattle on both farms, and the value of the animals are stated in pounds of milk and butterfat produced at given cost of feed bought—also by pounds. It is easily seen that I would have

to reeducate myself by the use of comparison tables before the performance of animals could be valued. The pedigrees running into a hundred or more are carefully printed and state the product of the various animals in the ancestry. All these herd records would be valueless unless translated and reprinted at a considerable cost.

The statement is often made condemning our present system on account of the variety of bushels used. I can not indorse this kind of evidence, because practically everything we buy and sell is now handled in 100-pound lots. Most quotations on potatoes, onions, etc., are made in 100-pound lots, the bushel not appearing. In fact, the 100-pound unit has gotten to be very nearly a standard in farm use in my part of the country.

I would be forced to spend hours checking up the records made on my farm by even a competent foreman, because of his lack of education in these new units. In fact, it would be years to come before one farmer could talk to another in intelligent terms by the use of this new standard.

6. My third objection to the bill is that it does not seem to be clear on what would become of a stock of tools the sizes of which are not either the inch system or the metric. I refer to a list of tools known as "alphabetical sizes" and "numerical sizes;" that is, from A to Z, inclusive, and from 1 to 80, inclusive. These sizes are demanded in large quantities, both in the United States and abroad, and while, of course, the size value of these tools can be expressed in metric units, and at additional cost so marked, there would be endless confusion, costly mistakes, and many returned goods if these tools could not be sold by their letter or number size.

7. Section 8 seems to provide for manufacturing for your own use in any desired system, but obviously, it is of no use to manufacture what can not be sold for domestic trade.

8. As previously stated, the company which I represent has made for many years tools of all kinds in metric sizes and welcomes particularly at this time the opportunity to continue to do so, but I can see no possible advantage to be derived from being forbidden by law to sell any tools made by the inch system of measurement except to foreign trade. We sell in foreign markets large numbers of tools made to the inch system as well as the metric. This means we would have to carry a double stock of the same diameter tools, one marked with inch sizes for foreign trade who required it, and the other marked in metric units for domestic trade and export metric trade.

To illustrate: For years to come the American trade would demand 1-inch tools, no matter what they are called, because their tools, jigs, and fixtures are too expensive to throw away. As we could not sell them 1-inch tools, they would have to buy its equivalent, 25.4 millimeters. They might order it either way; that is, 25.4 millimeter or metric equivalent of 1 inch. In any case, we would have to be prepared to furnish them a 1-inch drill marked 25.4 millimeters and we would at the same time have to be prepared to furnish to a number of export customers this same size drill, but marked 1 inch. Hence, both stocks would have to be carried, because the marking is done at a stage in manufacture too far from the finished stock to meet commercial conditions.

It should be understood that the nearest tool corresponding to this size (1 inch) for foreign trade to countries now using the metric system is 25 millimeters, so that for years we would have to carry three stocks of substantially the same diameter, namely: 1-inch drills marked 1 inch for foreign trade; 1-inch drills marked 25.4 millimeters for domestic trade; 25-millimeter drills marked 25 millimeters.

Any of these inch-system tools returned would be unsalable except for export, unless they were re-marked, and in a large number of cases re-marking ruins the tools or makes them unsalable except at reduced prices, and to this penalty must be added the cost of re-marking. This is an item of considerable importance, as may be seen from the statement that after the signing of the armistice, the company was forced to take back 4,110,913, besides the orders which were canceled for tools in process.

For the reasons just given, the passage of this bill (S. 2267) would not make effective the standardization sought for, because we would be forced to carry on the inch system as well as the metric, but under more arduous conditions than at present, because we would have to carry in stock the nominal

metric sizes, the fractional metric sizes of the equivalent inch sizes, and the present inch sizes marked in the inch system.

9. My fourth objection is its effect on general standardization. It is thought by some that the adoption of this bill will greatly promote international standardization, but this is not true. Standardization is not the adopting of any certain units of measure, and it can be brought about through any system of measurements.

Standardized articles are those which have proven their utility, and usually consist of the least number of sizes or types that will fulfill the requirements of the general public. As regards any particular article or commodity, it consists of an agreement to make that article or commodity to the specifications which define that particular standard. It is obvious that the physical properties and dimensions of any article or commodity can be suitable for all purposes and an agreement reached on the sizes and types by the use of any system of measurement.

American automobiles, machinery, equipment, and tools are now standardized to a higher degree than in any other country in the world, metric or otherwise, and this standardization has been accomplished by the actual physical and functional requirements of the product without regard to the system of measurements used in the construction.

American manufacturers have built up their business, especially their foreign trade, upon a recognition of the fact that they have adopted standards by the use of which their parts are made interchangeably and cheaply. It has been shown that the change in the basis of fundamental measurement will, by altering these standards, cause great confusion by them and compel the adoption of new standards. By this alteration the foreigner will see only our admission of error in our former practice with a consequent loss of the prestige that the American practice has built up after years of effort.

Standardization is for the purpose of interchangeability of units of manufacture or commerce, and it enables great economies to be effected by quantity production of a large number of articles which are so nearly alike that they perform their proper functions.

Interchangeable manufacture is strictly an American invention—indeed, it is referred to in Europe as "the American method." The automotive industries have spent endless time and money standardizing for the purpose of economical manufacture on an interchangeable basis, and to-day outclass in this respect European methods so far that there is no comparison.

It does not matter what the physical dimensions of these standardized or interchangeable parts are called—indeed they may be and often are designated by catalogue number—but the physical sizes of American standards must be retained, or all of American industries' time and money have been wasted, because it will have to be done over again.

10. The passage of this bill greatly endangers all American standards because the adoption of the metric system will require a translation of all dimensions into metric units, and these in all cases except the dimension 5 inches and its multiples will be fractional millimeters.

To illustrate: 5 inches equals 127 millimeters, 10 inches equals 254 millimeters, etc.; 0.5 inch equals 12.7 millimeters, ¼ inch equals 6.35 millimeters, and ⅛ inch equals 3.175 millimeters. It is impossible to think that other countries are going to adopt our sizes of machine parts, structural steel and other equipment with the dimensions in unheard of fractions of millimeter.

There will be a constant endeavor to lop off the fractions or add to them to make a nominal standard, then all our tools and equipment become special, and we must standardize all over again to meet this nominal or round number size. They would want to make everything now in use which is ⅛ inch 3 millimeters, but we could use none of our fixtures or tools because the size would be changed from 0.125 inch to 0.1181 inch, or about 0.007 inch undersize.

Take gearing for an example. It is highly standardized in the United States and one can buy gears in a city of any size that will fit and function properly with gears bought anywhere else; or, one can buy cutters anywhere to produce the teeth that will run properly. These gears are largely used all over the known world; there are millions of them. Will they fit the gears made by the metric system? No, unless the pitches and dimensions are translated in awkward fractions of a millimeter and adopted in other countries

is a standard. But they will not fit any of the gears now proposed by the metric countries. There is not a single pitch in the metric system that will fit the United States' system now so universally used.

Take the well-known 12-pitch gear used by the thousand in this country and carried in stock commonly by large machinery dealers. The nearest pitch to this in the metric system is module 2, but they will not run together because the metric tooth is 0.124 inch thick, and that of the United States standard is 0.31 inch; that is, the United States gear tooth would be 0.007 inch too thick for the space in the metric.

11. To get the metric countries to use our 12-pitch standard translated into a metric module would be to ask them to change from 2 module to 1.889 module. They would stand out against this awkward fraction and ask us to change our standard to 2 module, which would mean that the millions of gears on hand would no longer be interchangeable with the new product, and with millions of dollars worth of gear cutters now on hand in the various shops throughout the country, together with the necessary gauges for checking this product, would become obsolete except for repairing the old gearings.

12. Take the well-known automobile cylinder 3¾-inch bore, which is one of the standard sizes and of which one concern alone turns out 12,000 per day. The standard size of this cylinder is 3¾ inches, and it is so well established that pistons and rings can be had in practically every city in the United States which will fit. The metric translation of this size is 95.25 millimeters, and the question naturally is, "Will other countries adopt this 95.25-millimeter"? More than likely they will hold out for 95 millimeters, and if this should then become the standard, it is easy to see the effect on the manufacturer if he is forced to scrap his tools, fixtures, jigs, gauges, and highly specialized equipment when this change was made.

13. Take bolts and nuts, the most difficult of all interchangeable manufacture on a production basis. The United States makes more than one-half of the screw-thread product of the world, and it is the most interchangeable of any in the world. Any reputable manufacturer in the United States will make a 1-inch, 8-thread bolt or nut belonging in the medium-fit class that will fit within the limits of a bolt or nut made by any other reputable manufacturer. It has even been found that this fits with England's Whitworth 1-inch, 8-thread by aid of a little oil and a wrench.

14. The metric system has not a single diameter of bolt or pitch which will fit those now being made so extensively in the United States. The metric system of threads is not as logical as ours for origination. Our pitches are a certain number of turns of thread per inch or unit of length, while they work entirely from center of one thread to center of the next, and this for all fine threads becomes an awkward fraction of a millimeter.

15. There is absolutely no comparison between the methods used in the metric countries and those of the United States for originating the correct size of a screw or a thread gauge. This was plainly evidenced by the failure of the French mechanics during the war to make thread gauges which were interchangeable or which were to the dimensions prescribed for them.

The threads on three out of the five famous French 75-millimeter artillery field pieces sent over to the United States Army Ordnance did not interchange, nor did they conform to their drawing dimensions for these threads. The thread gauges they sent over to the United States to check the interchangeability of American-made guns did not fit the guns they sent nor did they check with the dimensions they were supposed to be made to.

It is inconceivable that American manufacturers are going to be asked to give up a well-standardized system of such importance for one that will never interchange, no matter how much we juggle the name of the sizes now in universal use.

16. It was estimated that the gauges, checks, and allied instruments made for war munitions which were on hand at the signing of the armistice cost the Government over $30,000,000. If this bill is passed a large number of these—perhaps half of them—will be of no use to the War Department unless they have been re-marked, and in many cases this will unfit them for use. The millions of dollars' worth of thread gauges made to the present system will not fit or tie with any metric threads.

17. One of the most valuable assets of our industry is a conception in the mind of the average American mechanic of the physical meaning of the dimension

"one-thousandth inch." All clearances, fits, and tolerances are known in shop language as one, two, three, or so many "thousandths." These dimensions are the mechanic's alphabet.

By the passage of this act this unit of measurement is abolished and the length indicated by 0.001 inch becomes 0.0254 millimeter. The mechanic or draftsman knows, by his years of experience and training, what kind of a fit or tolerance is meant by one, two, or three thousandths. These tolerances are so well known that they are expressed in plain decimals, without inch marks, and the physical conceptions expressed in simple, even numbers are understood by all shop men. The passage of this bill will, of course, mean these tolerance values will be translated into metric, and 0.001 will read 0.025 millimeter; 0.002 will read 0.05 millimeter; and 0.003 will read 0.08 millimeter; and, to avoid confusion, the millimeter will have to be used to indicate that it is millimeters and not inches. This means that the mechanic must arrive at some new conception of fits and tolerances expressed in even dimensions of the millimeter. The resulting confusion in the shops for years will be but little different from that which would result by changing the spoken language.

18. It has been my observation, based on many years experience, that the compulsory use of the metric system would penalize too large a majority for the advantage gained by a small minority. The line seems to be quite clearly drawn between those who perform their work nearly entirely with paper and pencil and the great mass of producers and people who deal with the actual physical representations of the standards. This proportion is more than a hundred to one, and works a hardship on the hundred to help the one who is best fitted by education and training to take the hardship, if any exists. The small proportion of the public who are benefited by the metric system are the best situated to use the present current units, even if it does not admit of rapid calculating decimally. The hardship is going to be in educating the millions into unknown units, and it will take 50 years—not 10, as the bill provides. In my estimation, the reluctance of the public, the expense, and confusion will be so great that before any great headway is made there will be a pronounced clamor for the repeal of the bill.

19. To further illustrate what has just been said, attention is invited to the fact that, with few exceptions, those not opposing this bill may be divided into two classes:

The first class of people who are interested primarily in ease of calculation and who use machinery to a very small extent. This group comprises doctors, chemists, scientists, etc. The tools and manufactured articles with which they are concerned are usually made in small quantities, no large stocks are carried, and their cost of manufacture is not limited by close competition.

The second class of people is composed of manufacturers who make articles on order only and do not carry stocks or manufacture in quantities. In this group we may consider locomotive and crane builders and makers of large special machinery. As their product is not standard, as they carry no stocks, and as their parts have little or no interchangeability, it is a matter of indifference to them to a large extent whether or not their system of measurement is changed between one lot of manufacture and another.

20. There is a third class, however, which includes the bulk of American industries and depends for its existence upon the production of interchangeable parts in large quantities. In order to do this, investments in special machinery, tools, and fixtures are very large. This class includes all those manufacturers who make articles and material for stock; it includes the manufacturers of all merchandise carried in stock by the manufacturers themselves, the jobbers, and the retail stores. It is this class which produces the merchandise directly consumed by the people, and they are the industries most concerned with the passage of this act. That they are almost unanimously opposed to its passage is due to the fact that they understand the confusion which will be caused in their production and the extra cost of the necessary help to inaugurate the new systems by its adoption. They understand the immediate depreciation that will be caused in the value of all their stock, tools, and fixtures. They also know that these must be replaced at a very premature date and that this will have the effect of increasing the cost of manufacture which must be added to the cost of the article and passed on to the customer.

21. In closing, I desire to offer as one of the most important reasons why the Cleveland Twist Drill Co. objects to the passage of this bill a tabulated expense which this company will be put to if forced to carry out the provisions of this bill. The figures in this tabulation are carefully computed for all items which can be reckoned with at this time.

1.

ESTIMATED COST OF INSTALLING THE METRIC SYSTEM IN THE OFFICE SELLING AND ADMINISTRATIVE DEPARTMENTS OF THE CLEVELAND TWIST DRILL CO. ACCORDING TO PROPOSED SENATE BILL NO. 2267.

[Economical working conditions are assumed, and stock to be in minimum condition at completion of the 10-year period.]

Publicity and sales.

EXPENDITURES INCURRED ANNUALLY.		EXPENDITURES INCURRED BUT ONCE.	
Extra salesmen necessary to cover present sales districts, due to delays in ascertaining customers' needs and to help specify orders	$10,000	Reediting catalogue, preparing new plates and republishing	$15,000
		Additional advertising campaign to instruct jobbers, dealers, and customers in ordering particular products under the new system	25,000
		Remarking, relabeling, and general rehandling of goods now in stock	5,000

Billing, accounting, and shipping departments.

In distributing 1,500,000 tools monthly some 50,000 items are billed to some 10,000 customers. The introduction of a new system of measurements, as proposed by bill S. 2267, will result in a huge increase in special orders, much confusion and numerical errors by customers in attempting to order under the new system, a heavy correspondence to correct these customers' errors, and also a heavy expense for shipping and rehandling of goods sent in error. The cost of this increased work over present costs is estimated to amount to 10 per cent in shipping, 30 per cent in billing, checking, and cost accounting, and 40 per cent in stenographic expense, total	$23,000		

Purchasing department.

		Revising all data used in purchasing supplies	$2,000
		Loss on raw steel in stock due to increased wastage in turning down to metric sizes	25,000
		(See under manufacturing department for details.)	

Financial burden.

To render adequate service to customers it will be necessary to greatly increase finished stock in standard millimeter sizes, while still continuing to carry a large stock in English sizes remarked in millimeter dimensions. This increased inventory will tie up at least $500,000 in additional capital. Interest, taxes, and insurance on this investment at 8 per cent will amount to	$40,000	Cost of 10,000 square feet of additional shipping room and office space required to house the increased clerical force and increased finished stock, at $4 per square foot	$40,000
Interest, depreciation, taxes, insurance, and maintenance, at 10 per cent, on $50,000 of building and equipment needed to house this increased stock	5,000	Increased office and storeroom equipment repaired	10,000

Administration expense.

Increased charge for executives and executive assistants exclusively engaged in supervising the change from the old system to the new	$15,000		
Total expenditures incurred annually			$93,000
Total expenditures incurred but once			122,000

MANUFACTURING DEPARTMENT.

All expenditures as shown incurred but once.

ENGINEERING DEPARTMENT.

The drawings of buildings, sewer, and underground pipes, power equipment, and the drawings of special machinery, jigs, fixtures, gauges, and the whole line of product manufactured will have to be translated over to the metric denominations. All dimensions except those which are multiples of 5 inches will be in fractions of a millimeter. These millimeter fractions must be retained because it will be impracticable to change the physical dimensions of most of the machine, jig, and fixture parts.

A great many of the working lists will have to be made over because there is not space enough on them for these millimeter fractions. Where the work is to close tolerances, as in drill and reamer manufacturing, the translation from English to metric will have to be carried to one-hundredth millimeter in order that the combined tolerances in any straight line will not accumulate an error beyond the present over all tolerances. It will take two competent engineers and two assistants 400 days at 10 hours per day to make this change, the cost of which will be $16,000.

PURCHASING DEPARTMENT.

All records will have to be translated into metric units to enable them to make proper comparisons for new purchases. Raw material on hand will have to be rearranged to suit the new conditions. The stock of steel, 1,289 tons, valued at $645,000, will have to be arranged to conform to the metric units, and in many cases the amount turned off of this steel to make the metric units will have to be increased to avoid scrapping it. This extra material wasted costs from 15 cents to $1.25 per pound. There will be 205 sizes, each of three kinds of steel (615 sizes in all for regular product only) affected by this change. There will be 151 sizes each of two kinds of steel, the size of which is now finished, and any of this material left in stock at the time of change will be of no use for metric sizes.

FACTORY OFFICE.

Increase in sizes of routing books	$500
A large majority of duplicates of special orders which are kept for a permanent record are English sizes, and the adoption of the metric system will make them almost worthless or require translation at a cost of	2,000
Change in all shop orders for tools in the factory which have not reached the point of stamping	200
Additional rubber stamps for stamping orders	70
Increase in sizes of the following forms of stationery: Steel sheets, control cards, sales, production, and new lots report, and lot number cards	50
Increase in guides and inserts for the following files: Stock in process file, special order file, lot number file, statistical department file	80
Change will necessitate two comptometers and one Burrough's adding machine in the statistical department	1,365
Total cost of equipment	4,265

It will be necessary also to add two or three counters to the size field on the tabulating machine. This will mean the designing of a new machine (cost unknown).

PRODUCTION DEPARTMENT.

Cost of unnecessary instruments calibrated in inches which can not be changed over	$19.000
Cost of re-marking measuring instruments which can be changed over	4,000
Re-marking existing standards and gauges which would have to be retained as special metric sizes	3,000
Additional necessary metric standards and gauges	3,200
Relabeling pigeon holes, racks, etc., in factory	1,500
Additional pigeon holes, racks, etc., to carry new stock	5,000
Reprinting production forms, records, and statistics (this includes cards and forms for tabulating machines, punching machines, and collecting machines)	20,000
Guides used on machinery which would be obsolete due to changing size	15,800
Immediate replacement	15,800
Stamps, etc., obsolete	8,000
Additional labor to get present production due to confusion, $3,200 per month for first year	38,400
Cost of training additional employees to use metric measuring instruments	20,000
Spoiled work under most favorable conditions, $5,000 per month for first six months, half of this for next six months	45,000
Remodeling jigs and fixtures on machines to suit metric sizes	20,000
Nothing allowed for bolts, screws, nuts, gears, cutters, etc., whose dimensions would be translated into fractional metric sizes and their physical sizes maintained, rather than have two standards with the resulting confusion.	
Total expenditure for production department	218,700
Grand total expenditure for all departments	453,965

Mr. STUTZ. I have here an article written by a Belgian engineer, R. Blockhouse, Liege, Belgium, which, without objection, I would like to be made part of the record, to show what the conditions actually are to-day.

The CHAIRMAN. It may go in the record.

(The article referred to is here printed in full, as follows:)

THE METRIC SYSTEM IN BELGIUM.

LIEGE, BELGIUM, *June 23, 1921.*

In conformity with the International Convention of 1830, Belgium adopted for official use the metric system.

At the beginning, very naturally, certain difficulties of application have been encountered, and it is probably due to the fact that Belgium is a little country,

and that at that time her industry was barely beginning to develop that the necessary transformations could be made in the usage and habits of the people.

Although the metric system is considered the only official basis in Belgium, nevertheless it became necessary to deviate from this general rule in regard to the use of measurements for land, for textiles, for masonry work, and for pipes, pipe fittings, bolts, screws, etc.

In fact, it was found impossible to transform the methods used in measuring land because such changes would have produced practically unsurmountable complications. For a long time land has been measured by bonniers, verges, and other similar measures. If it would have been necessary to transform these old measures one would have arrived at the fatal necessity of changing the limits of properties, which is an impossibility in practice.

However, for official acts, hectares, hundreds of ares, etc., are used, but verges, bonniers, etc., remain practically the only measures in use in the relations between owners of land.

As regards textiles, we suppose that the English measurements have been preserved for the reason of the numerous relations existing between Belgium and England in this field of activity, and especially for the reason of the dominating position the latter country has in the field of textiles. We note, therefore, that in Belgium to-day, in certain cases, textiles are sold according to English units of measurement, and in cases very much less numerous according to the metric system.

As regards measurements referring to pipes, English units of measurements have been exclusively maintained everywhere. In Belgium, pipes are sold in inches and in fractions of inches.

Pipe, fittings, valves, etc., are threaded according to feet and inches. This originates probably from the fact that much of our equipment for steam heating, water and gas installations are furnished us by England.

As to the usage in reference to bolts, nuts, etc., we have equally conserved the units of English measurements and this for the reason that it is England who furnished us first of all the automatic machines for the manufacture of such articles and Belgium being a country with works enormously in the field of exportation, we have been obliged to preserve and adopt these units of measures as our "standard" in order to be able to conform to the numerous demands which come to us from abroad. It follows from this situation that all wrenches used for tightening nuts are equally manufactured in inches and in fractions of this unit of measurement.

Concerning works of masonry, we are confronted by a typical fact.

For a very long time in building construction, measurements have been used conforming to essentially local units. In fact, we are using an inch called the "mason's inch," which is about 30 mm. long. The "mason's foot" contains only 10 inches and in practice it has been impossible to suppress the use of this measurement, so that at the present hour, our stores actually furnish special rules for the purpose of measuring work of this kind exclusively by these local units.

We have furthermore, as a unit of measure, the "inch of Paris," but this is, however, less frequently used.

It follows from the above expose that although Belgium has adopted and put into practice the metric system, she has been forced to make exceptions in very numerous cases and according to our personal knowledge, no effort whatever is being made to bring into uniformity these various units of measuring.

One can easily understand the practical impossibility of such an effort. One need only reflect for an instant what disorganization and discontent such an endeavor would provoke among the numerous people using these old measures, which old measures represent, in fact, one of the essential tools of their profession.

We find, furthermore, that in mechanics and in general industrial constructions we have been forced to apply very often indeed the English units of measurement. In fact, as we have mentioned above, Belgium is a country which exports a large part of its metallurgical and mechanical productions, which fact has compelled us to construct all kinds of machines and equipment for England, America, Japan, China, Russia, etc. It can be readily understood that these countries, in entrusting to us their orders, have furnished us plans and designs established according to their units of measurements. We have therefore been obliged to work for a great many countries by using the English inch, its fractions as well as its multiples. And even for Russia we

have been obliged to often work in their complicated system of "lignes" and other units of measurements.

We wish to cite as a typical example, the manufacture of artillery material of which several large Belgian concerns have made a specialty, especially in the manufacture of numerous pieces demanding great precision in the machining of their parts. It has been found that it was practically impossible to transpose foreign measures into metric measures and vice versa without creating differences which, though small as they are, are sufficient to prevent the proper functioning and adjustment of these pieces. There remained therefore only one way open, this was to machine the material according to measuring instruments adopted by the countries which entrusted their orders to us. We have therefore been obliged to train our workers to understand and to use different units of measures, commonly used anywhere in the world.

It is evident that this situation is very difficult and has handicapped us in the beginning as far as the cost price of manufactured material is concerned. Nevertheless our force of habit and of enterprise has taken note of these difficulties and at the present hour in Belgium we work easily with the metric system and all other systems adopted by our foreign clients.

We wish to say, however, that according to our view, if we should at present completely abandon the metric system we would find ourselves with a problem practically impossible of solution, because it is the system which is taught in all our Belgium schools and it is the system currently employed for the needs of the country. Doubtless the metric system is very simple, and many cases will readily prove this. A radical change in the order of ideas (as concerns a system of measurement) is proportionally difficult, as a country is large and its industries developed. The consequences of such a change would translate themselves into a complete disorganization and entail expenses which probably no country could possibly afford. In summing up our observation, we can say that Belgium seems to be the place where one can best realize the importance of conserving a system of measurements which has been adopted for a long number of years and where one can realize the difficulties which are created by the necessity to use several unrelated methods for measurement.

R. BLOCKOUSE.

The CHAIRMAN. Have you any other witnesses for to-day?

Mr. STUTZ. No, sir. We have witnesses called for to-morrow, and we hope then to be able to close our case.

The CHAIRMAN. We will adjourn until to-morrow morning at 10.30 o'clock.

(Whereupon, at 11.30 o'clock p. m., the subcommittee adjourned until to-morrow, Friday, December 16, 1921, at 10.30 o'clock a. m.)

THE METRIC SYSTEM.

FRIDAY, DECEMBER 16, 1921.

UNITED STATES SENATE,
SUBCOMMITTEE OF THE COMMITTEE ON MANUFACTURES,
Washington, D. C.

The subcommittee met, pursuant to the adjournment, at 10.30 o'clock a. m., in the committee room, Capitol, Senator Charles L. McNary (chairman) presiding.

STATEMENT OF MR. EDWIN H. MARBLE, PRESIDENT CURTIS & MARBLE MACHINE CO., WORCESTER, MASS.

The CHAIRMAN. Kindly give to the reporter your name, address, and occupation.

Mr. MARBLE. Edwin H. Marble, president of the Curtis & Marble Machine Co., Worcester, Mass., manufacturers of textile finishing machinery.

This firm probably covers the largest field in the textile industry of any firm in the world, taking fabrics from mosquito netting or gauze up to rattan mats, and from braids to the widest carpets.

The CHAIRMAN. Are you familiar with the bill to fix the metric system as the standard system of weights and measures?

Mr. MARBLE. I have read it over carefully.

The CHAIRMAN. Mr. Marble, will you make such statement as you desire which will be pertinent to the inquiry?

Mr. MARBLE. Representing the textile industry, there is an old saying that the three essentials of civilization are food, clothing, and shelter. Clothing practically means the textile industry.

At a gathering in Manchester last June, known as the World Cotton Conference, there was passed a resolution protesting against the compulsory use of the metric system. I have here a copy of it which I would like to have made a part of the record.

The CHAIRMAN. It will be incorporated as a part of the record.

(The resolution referred to is here printed in full, as follows:)

"Recognizing the fact that the English system of weights and measures is in use in nearly all textile-producing countries, and that the English "pound" and "yard" are closely identified with the industry as a standard, the committee registered a protest against the compulsory introduction of any other system of measurements.

"Presented by the American section of textile machinery committee.

"Approved by the entire committee, including both foreign and American textile machinery builders.

"Indorsed by committee of growers, ginners, spinners, manufacturers, converters, banking, and transportation, and adopted without a dissenting vote by the entire body of delegates representing nearly every textile producing country, metric and nonmetric."

Mr. MARBLE. That resolution was considered by almost every phase of the textile industry. First, the grower of cotton and the grower of cotton seed. He buys seed that is supposed to produce a given standard of cotton not merely in quailty, but in length of staple. That length and quality is determined by standards issued by the Department of Agriculture. These standards are not only recognized in this country, but in almost all foreign countries. I saw them in use in England, in Belgium, and in France, and I am assured that they are in use in China, Japan, and in South American countries.

The grower produces a staple, compared with the United States standards that is $\frac{3}{4}$, $\frac{7}{8}$, 1 inch, $1\frac{1}{8}$ inch, or longer. If the bill which we are considering is put into operation, he can ship to China and Japan, or to any of the European countries, according to the standards which are in existence at the present time. If he has to ship it across his fields to a neighborhood cotton mill he is obliged to convert those standards into a metric equivalent. He has got to make arrangements for transportation according to metric equivalents.

There are very few of the English standards that can be converted into easily remembered metric equivalents. At the wool-cotton conference in New Orleans three years ago the committee on research and statistics presented a resolution which called for all handling of cotton to be prepared along the basis of a 500-pound bale, and that the cloth be governed by the yard. That is the recognized standard practically throughout the world, as the standards of length and quality are recognized standards throughout the world.

Going forward from the grower, the transportation, the warehouse, the bankers, have all got to consider the cotton, amounting to some 8,000,000 or more bales a year, along either English or metric equivalents.

Coming to the spinner and the weaver, he has got to make changes all throughout his process of manufacture so as to introduce a dual system, manufacturing either according to present methods along English lines, or introducing metric equivalents, a great many of which are very unsatisfactory.

Referring to the manufacture of yarns, No. 40 is a recognized standard of yarns. The metric equivalent is, I think, $32\frac{8}{10}$ or 32.8 The other standards, as fixed by the United States Government for the sizes of yarns, have all got to be changed into metric equivalents.

Going to the converter, unless he receives his goods by the meter he has got to convert all of his formulas for the processing of those goods so as to meet this metric equivalent, or he has got to take each lot of goods and change them from the metric measurements, under which received, into yardage to meet his formulas in existence.

Here [inudicating] is a fair example, an ordinary 7-color print cloth. There are 21 processes, from the gray—the original color of the goods—to the finishing process, and 17 of those have got to be converted. Incidentally there are 100 ingredients in the colors in this piece, and the mixing of those ingredients has all got to be changed to meet anything besides the English system.

There [indicating] is a piece of English goods which is a copy of a French piece of goods. The French plant from which the original piece of goods came I visited, and all of the measurements in the design of the pattern were in English units. There are 12 colors there and about 135 ingredients. That is a piece of ordinary drapery cloth.

Here [indicating] is a piece of goods known as the Fruit of the Loom. It has been a standard for 40 years. It is so much of a standard that the United States Government in making its figures, bases its calculations on the Fruit of the Loom to obtain the difference in cost between the cotton and the finished product. When you go and buy Fruit of the Loom you buy a piece of goods that is 36 inches wide, and that has been so for 40 years. You buy a piece of goods with an 85 by 90 pick, or threads, to the square inch. You buy a piece of goods that has a certain known weight in pounds per yard. A woman going into a store does not ask for 36-inch goods. The picture tells her it is 36.

The name Fruit of the Loom is, as I have stated, a recognized standard. It is not only a recognized standard here, but in England, from which they are figuring some of their calculations. The Japanese manufacturers are to-day advertising Japanese Fruit of the Loom, made, as nearly as they can make it, to exactly the same standards that those goods are made.

Those [indicating] are practically the same goods, only with a little different table indicating a different type of finish.

Practically all the goods that are put upon the market at the present time are either put out in the form of a roll, or bolt, or a fold. The measurement of the goods in the roll is obtained by passing the goods over a drum of a known circumference, either half a yard, a yard, or 2 yards.

If they are to measure the goods by the metric system the easiest figures to remember are 35 thirty-seconds; that is, there are 35 yards practically in 32 meters. Another of these drums could be converted by a compensating gearing to measure by the metric system. However, for export they would want the English system and for America they would want the metric system, if the provisions of the bill are carried out.

The goods that are put up in folds introduce an entirely different feature. And let me state here that it is not for any selfish motive that I bring in this point. There are only two manufacturers of cloth-folding machines in this country. The machines are very similar in general principle. We have manufactured over 1,100 of these machines. The other concern, considerably older in this particular line of machinery, has manufactured a little larger number. Of that number there are about 80 per cent that are for just 1-yard folds, and those machines can not be changed into a meter fold. The construction of the machine prevents it. In other words, there are about 800 machines of our make, a large proportion of which would have to be scrapped. There are some 900 machines of another make that would have to be scrapped if they were obliged to put goods up in the metric system.

As payments for weaving and finishing these goods are based on the folded yard, all these figures would have to be calculated with any change to the metric system.

As to the honesty of the industry, I think we have a pretty fair illustration in the use of these machines. Very rarely when a woman goes into a store to buy 5 yards of Fruit of the Loom will she expect the saleslady to put a yardstick on it. She counts the number of folds. She believes that the manufacturer of the machine has been honest and made a machine that will measure just a yard. She believes that the manufacturer of the cloth has been honest and put just a yard into it. I do not think there is 1 in 100 that ever measures the length of the fold after she receives it, any more than you would think of measuring a 200-yard spool of thread made by the O. N. T. or Clark people. Those are recognized standards, not merely by the manufacturer, but they touch all fields and all conditions.

These same machines have been made for export to Belgium, France, South America, China, Japan, and Russia. We have never sent but one machine that would fold a meter out of this country. We have furnished within two months machines for China which is to be a metric country very shortly—so claimed—one of them for the Chinese Government and one for the Japanese Government, on which you can not fold a meter. If they are to be a metric country, they are not preparing for it at the present time.

There is another point which is quite interesting. All carpets are made to fixed or international standards of measurement. English carpets, French carpets, and German carpets are made to a three-quarter or a yard width. I saw rugs the other day in New York which had just been brought in from Germany, and they were billed as 9 by 12 rugs; that is, 9 feet one way and 12 feet the other way, or as we would usually call it, a 3 by 4 yard rug. They were not billed as metric rugs. A 9 by 12 rug would be about a 2¾ by 3⅔ metric rug. Not a figure easily remembered.

If a woman calls for a 36 by 60 rug, which is a recognized size, she gets it in the English measurement; and some of the foreign rugs are brought in on exactly the same size, particularly some of the Japanese rugs which are being brought in at the present time.

The matter of packaging goods put up by the metric system is quite interesting, inasmuch as the packaging is now done for recognized standards, and the sizes of the shelves in the stores, the depths of pockets, are made to meet English measurements rather than metric.

From a manufacturing standpoint, taking the ordinary blue print from our stock, the machine for which that particular piece of print is used, has been furnished to England, France, Germany, Italy, Russia, and Japan. If a party in Russia or Germany sends for a piece of this machinery according to this blue print we would send it to him as the machine was originally made, under English equivalents.

If one of our neighbors, about 12 miles from us, has that same machine, and orders that part, we would have to send it to him in the metric system. It is a confusing dual system all the way through.

Referring to this resolution which was presented at Manchester, I want to trace it from the beginning. About 200 delegates left America on the 1st day of June. In that delegation were members of nine different committees covering the different fields or phases. The speaker was a member of the committee on research and statistics, and also the secretary of the committee on machine builders.

The resolution started in among the machine builders. It was prepared by the secretary, and was indorsed by the American section as a unit. It was

then passed to each of the different committees on the boat, being indorsed or approved by each one of those, and came back to its birth.

Reaching Manchester the international committees met, the American section joining themselves with the English, French, and Belgium sections of textile manufacturers. There were representatives there from Portugal, Spain, Italy, France, Belgium, Norway, Japan, China, Brazil, the United States, Canada, and England and all of its colonies.

The resolution was not considered by the international committee of machine builders to be drastic enough, as originally prepared by the American section. From the international committee on textile machinery it was sent in sequence to the committee of growers. It received their unqualified indorsement. It went from there to the different committees and came back with the indorsement of every one of the committees, representing metric and nonmetric membership, and then was presented to the Convention as a whole, over some 600 delegates, and was passed without a dissenting vote.

I do not think there is any industry that has considered the introduction of the metric system so carefully as aid these accredited delegates from all of the different phases of the textile industry. A short time afterwards I met a French delegate to the International Chamber of Commerce in London and afterwards in Paris. He is himself a very firm advocate of the metric system for governmental work, but states that it is an impossibility in his line of work, which is a line of fine dress goods, silk and linen, to introduce the metric system—that is, into his own plant—inasmuch as he buys the linen from one section, he buys his cotton or his silk from another section, and each have adopted the English measurements for producing their raw product.

Two American delegates to the International Chamber of Commerce went over this thing quite carefully, both of them representing, perhaps indirectly if not officially, the World Trade Club of California, and both of them admitted that it would be very much of a task to introduce it into the textile industry, inasmuch as it affected everybody, from the man who started to plant the cotton to the woman who bought it. One of them went so far as to suggest that he would be willing to advocate the withdrawal of the textile industry from the provisions of this bill. The textile industry, however, is so firmly tied up with all the other industries that I think we do not care about being excluded.

I believe, Mr. Chairman, I have covered briefly some of the different phases.

The CHAIRMAN. It is most interesting, Mr. Marble. You have read this bill, I presume?

Mr. MARBLE. I have.

The CHAIRMAN. If made compulsory at all, do you think the period of transition of 10 years is too short?

Mr. MARBLE. I do not believe you can efface memory in 10 years. The yard is so firmly fixed throughout the world as a standard in textiles that I do not believe a generation would efface it.

The CHAIRMAN. If it could be done overnight, without compulsion or cost, would you say it was a better system than the one we have now?

Mr. MARBLE. We have built those machines for 20 years; they are running today. I do not believe they would run any better or last any longer if made by the metric system.

The CHAIRMAN. Would a standard throughout the world of weights and measures be preferable to the number that now obtain? If all nations came to the metric system would it be better for commerce and the convenience of trade?

Mr. MARBLE. Yes; I think a standard that was adopted by everybody would be a splendid proposition—not necessarily the metric.

The CHAIRMAN. In theory is not the metric system better than the English system?

Mr. MARBLE. I can not say that it is.

The CHAIRMAN. From your state of mind and experience, you would not advocate the enactment by Congress of any legislation with regard to weights and measures?

Mr. MARBLE. No; I would not. Let me tell one little incident that perhaps may illustrate some of the conditions. A friend, a textile manufacturer, visiting French China saw in one of the windows some block-printed China silk. He went in to see about the price of it, and after some dickering they were offered to him for a dollar a yard. He speaks French and carrying on the conversation decided to take the piece. The storekeeper, taking down the piece, placed one end in his hand and reached out a yard, counted "Un, deux,

rois, quatre, cinq, no sēx; five dollars and seventy-five cents." He used the French system of counting, the old English nose to finger yard, and the Yankee dollar, to make the transaction.

The CHAIRMAN. The committee thanks you, Mr. Marble, for your appearance here.

Mr. MARBLE. If there are questions you wish to ask, I will be glad to answer them if I can.

The CHAIRMAN. I think you have covered the matter very thoroughly.

Mr. STUTZ. Mr. Chairman, Mr. Wilson has a short statement he would like to make.

STATEMENT OF MR. WILLIAM C. WILSON, AMERICAN INSTITUTE OF WEIGHTS AND MEASURES.

Mr. WILSON. Mr. Chairman, I do not care to give any oral testimony, but I have prepared a brief that I would like to submit for the record, with the hope that it will be of some service to the committee.

The CHAIRMAN. I am sure it will be, Mr. Wilson, from your large knowledge of the subject. It will be made a part of the record.

(The brief referred to is here printed in full, as follows:)

BRIEF IN OPPOSITION TO THE LADD BILL (S. 2267) PRESENTED BY WILLIAM C. WILSON, AMERICAN INSTITUTE OF WEIGHTS AND MEASURES.

1. The Ladd bill, as well as any other bill providing for the compulsory adoption of the metric system, under whatever guise of restricted application, necessarily involves the broader question of the ultimate complete substitution of that system in place of the English. Therefore, the fundamental question is not whether the Ladd bill shall be approved, but rather whether the metric system shall be approved in such form as that Congress shall pledge itself to the principle of compulsory metric adoption and is ready to enter upon a process of mandatory legislation to that end; for unless Congress is prepared to go the whole way in making our system of weights and measures exclusively metric for all uses, it surely would not be willing to enact into law a makeshift, such as the present bill, and let it go at that.

2. As the case now stands, both the English and the metric systems are open to voluntary use in this country. The Ladd bill now proposes that the metric system shall be made compulsory "for certain uses" and that the English shall remain voluntary for certain other uses. It asks Congress to put a metric tag on certain lines of business without reference to other lines.

3. It does not pretend to establish a system. On the contrary, it proposes to disrupt present uniformity and efficiency by introducing a disturbing factor. It is not constructive, because it seeks to take away from the people a confirmed and traditional instrument of trade and to put in its place a hybrid, conglomerate mixture that could only lead to utter confusion if put into practice. The bill represents the attitude of many metric faddists who apparently are willing to temporize with the present and speculate on the future if, through any kind of compulsory adoption, the metric system may be fastened as a leech on the established order. Hence, the issues presented by this bill involve the manufacturer as well as the tradesman, the farmer, the mechanic, and all other classes of people.

4. Metric legislation has followed a fairly uniform course everywhere. The first step is the simple legalizing of the metric units. Of this our law of 1866 is an example. The metric party of that date confidently believed that, with the use of the metric system made legal, its supposed advantages would soon lead to its general adoption.

5. This failing, the next step usually is the passage of a law making the use of the system compulsory for governmental purposes only. Such a bill was the subject of a series of hearings before the House Committee on Coinage, Weights, and Measures in the Fifty-eighth and Fifty-ninth Congresses and was killed in committee. The record of these hearings was published as a part of the public records and, of course, is available to the members of this committee.

6. These laws failing to produce the desired results, the next step is compulsion for all purposes, with, perhaps, certain exceptions.

7. The present bill is an attempt at an intermediate step, making the system compulsory in domestic trade but not in manufacture, presumably in an effort

to side-step the strenuous opposition to compulsory adoption by the great bulk of American manufacturers.

8. The essential failure of compulsory metric legislation has been demonstrated time and again and is based upon reasons which are deep rooted in the very nature of things as well as in the inherent weaknesses of the system itself.

9. Doubtless one reason why Congress has declined to pass compulsory metric laws is that there has never been a popular demand or anything approaching a general sentiment in favor of it. Indeed, it is hardly necessary to state that the average American has given no thought whatever to the compulsory adoption of the metric system or to the practical and economic problems which would surround its introduction. Certainly any claim that public sentiment had crystallized in favor of metric adoption would be a palpable absurdity.

10. It requires no argument to prove that radical legislation, disturbing the traditional and established habits of the people, and in the absence of a popular demand, is not only futile, but is a politically dangerous exercise of the legislative function. The people instinctively resent such interference unless there is a compelling reason so strong as to silence opposition.

11. Clearly it is not sufficient that the advocates of a proposed new system may claim that it is better than the old or that it may be better in fact. There will be no general demand for a change unless the people have found the old system to be so deficient as to require a change and therefore are willing to suffer the expense and turmoil incident thereto. But even in such event the character of the change should reflect public sentiment rather than the opinion and theories of a restricted class, especially if there should be a radical difference of opinion as to the merits of any proposed new system over the old.

The strong adherence to our present system by manufacturers of machinery, tools, appliances, etc., in which the element of weight and measure forms an important and intricate engineering and mechanical factor and the absence of any expressed dissatisfaction with it by the people at large, who are using it constantly in their daily activities, present a demonstration of its practical utility and merit sufficient to furnish a complete refutation of theoretical arguments in favor of legislating it out of existence.

12. The arguments of the supporters of the bill are based largely on three advantages claimed by them for the metric system:

(1) That the units of length, volume, weight, etc., are interrelated so that calculations involving the interrelation of such units are "greatly simplified."

(2) That each unit is decimally multiplied and subdivided.

(3) That the same name denotes the same thing.

13. As to the first point, there is no showing that the interrelation of units is of importance in the ordinary transactions of trade whatever its value may be in scientific calculations or the experiments of the laboratory. The bill imposes the system on the sale of "goods, wares, and merchandise," and we have yet to be informed how the sale of grain, beef, hay, dress goods, or groceries, etc., would be facilitated by the interrelation feature of the metric system. As a matter of fact, its practical value would be nil.

14. As to the second point there is a failure of proof that because the use of decimals is adapted to easy computation it would be of equal advantage in the actual process of physically measuring or weighing things, either in manufacture or in trade. A decimal system of weights and measures labors under the immense disadvantage that 10 has only the factors of 5 and 2, whereas 12 has 6, 4, 3, and 2. By division of its units into tenths the natural method is sacrificed to a superficial method. The binary division of a unit into halves, quarters, eighths, etc., is the universal, natural system. It was followed by the ancients and is common to every people the world over. It is the method by which the human mind easily, if not instinctively, visualizes the parts of a whole. Proof of this principle is presented by the use in metric countries of the binary division of their units in the ordinary trade of the people, thereby discarding a primary metric element and adopting the English method. Our decimal currency labors under certain disadvantages to which it adjusts itself by the people paying the price. If an article is quoted at, say, 75 cents a yard or pound, the purchaser pays tribute to the extent of one-half cent if he buys less than the unit quoted. The annual total of such transactions would doubtless run into the millions. Decimalization works best when the conditions to which it is applied can be controlled and adapted to it, as in the laboratory.

15. As to the third point, the fact that the same name denotes the same thing in the metric system and not in the English does not furnish a sufficient basis for a change to metric. Many words in the English language have a number of meanings, thereby rendering it difficult for a foreigner to learn it. Like our system of weights and measures, our language has been denounced as illogical, unscientific, a hodge-podge, and much inferior to the French; but no one has yet suggested a law providing that after a fixed waiting period the French language shall be substituted and the use of the English prohibited. The several meanings to the same word causes no confusion to an American any more than it does in his system of weights and measures. No one confuses a quart measure of potatoes, for instance, with a quart measure of milk. Furthermore, sales by weight are rapidly supplanting the dry measure in the markets of this country.

16. Mr. Bearce, of the Bureau of Standards (p. 144), takes up the case of the farmer, the merchant, the shopper, and others in an effort to show the advantages to them of the metric system. He propounds a number of hypothetical questions which he fails to answer. There is no attempt made by him to apply the metric system to the conditions named and demonstrate its practical value.

Mr. Bearce contends that what is good for the scientist should be equally advantageous to the people; that the processes which he finds valuable in his work should be equally adaptable to the ordinary transactions of business. It is upon this very fallacy that the metric argument must fail. There is no fundamental or superficial relation between the work of the astronomer and the farmer; the physicist and the grocer; the laboratory chemist and the dealer in real estate. The intricate and profound calculations of the astronomer are so essentially different from the comparatively simple problems of the farmer that it would be surprising if the requirements of his work should not demand a system peculiarly suited to it rather than to the business of farming.

17. There is an absence of convincing facts or arguments that the requirements of trade and commerce are not adequately fulfilled by our present system. The points made are either of relatively small importance or concern matters which, in large part, could be remedied if the governmental agencies, charged with such duties, were as active in improving our present system, if need be, as they have been in trying to substitute the metric system in its place.

18. One of the peculiar notes running through the testimony of the metricites is an effort to make it appear that business is conducted in a fraudulent manner and that metric adoption would remedy the evil. Take the case referred to by Dr. Wiley (p. 122). Pears are quoted at 45 pounds to the bushel in Oregon and 65 pounds in Tennessee. Would the weight of a hectoliter of pears be reduced to a uniform standard of weight throughout the country? If Congress could standardize the weight of a hectoliter of pears under the metric system, can it not likewise standardize the weight of a bushel of the same commodity under the English system? Mr. Williams, of the National Wholesale Grocers' Association, complains (p. 132) of the numerous and odd-sized tin packages in use. He refers to the 6, 6¼, 7½, 7¾, etc., ounce tins and seems to think that the only way to change these sizes is to change the whole system. Who is responsible for these various sizes? If they are in response to a trade demand, then they would continue under the metric or any other system. If they have been imposed upon the people by the wholesalers or other dealers, then they themselves are responsible and certainly not in a position to seek the aid of Congress in reforming their own business methods.

19. Several prometric witnesses expressed dissatisfaction with the present bill. A number specifically favored metric adoption by Government departments. As hereinbefore stated, this scheme has already been considered by a congressional committee and rejected. Under the law of 1866, the metric system is and has been open to voluntary adoption by the departments at any time. They have not done so, presumably for reasons which they consider to be sufficient. To compel them to use it exclusively as a method of foisting the system on the country involves the same fundamental and practical objections which apply to any other method of compulsory adoption.

20. The metric system is a propagandist system. It has its heralds and evangalists, such as the World Metric Standardization Council, constantly singing its praises and seeking its extension into new fields. On the other hand, the English system has maintained its preeminence through the natural avenues of trade and commerce on its inherent merits. International trade carries its own tools, and the dominant factors in that trade will inevitably impose their standards in the commercial markets of the world. Nothing can stop the growing commercial power of the English-speaking nations, and this

would seem to be a peculiarly inopportune time to consider the scrapping of the system of weights and measures upon which our industrial and commercial supremacy has been built.

21. The final test must be the survival of the fittest under the law of natural selection. Whatever legislators may do, the ultimate result must be in harmony with that law. We are entirely willing to leave the solution of the issues between these two systems to the orderly processes of evolution in American industry and trade.

Respectfully submitted.

WILLIAM C. WILSON.

Mr. STUTZ. Mr. Russell would like to make a brief statement.

STATEMENT OF MR. SAMUEL RUSSELL, OF WASHINGTON, D. C.

Mr. RUSSELL. I have a prepared statement which I will submit, to be made a part of the record, and have nothing further that I care to say on the Ladd bill.

The CHAIRMAN. Very well. It will be placed in the record.

(The statement referred to is here printed in full, as follows:)

I oppose the bill wholly from the standpoint of what I regard as sound public policy.

Senate bill 2267, entitled "A bill to fix the metric system of weights and measures" for the United States, and forbidding any person to "sell any goods, wares, or merchandise * * * or to charge for the carriage or transportation of any goods, wares, or merchandise," * * * weighed or measured by a "device designed, constructed, marked, or graduated in any other system than the metric system of weights and measures," brings to mind that passage of the Holy Scriptures, recorded in the thirteenth chapter of the Revelations of St. John, wherein it is written "and I saw another beast coming up out of the earth, and he had two horns, like a lamb, and he spake as a dragon; * * * and he shall make all, both little and great, rich and poor, freemen and bondmen, to have a character in their right hand, or on their foreheads; and that no man might buy or sell, but he that hath the character, or the name of the beast, or the number of his name." If I were a preacher, which I am not, I would say that the character referred to or the name of the beast and the number of his name would be "Metric," and that the intent of this scripture is that a beast shall arise which shall forbid any person to buy or sell except by the weights and measures of the metric system.

We are fortunate, however, in this free country that there is no bolshevist directory to impose the metric system upon the country by arbitrary decree as was done by the communist directory of the French Revolution at the close of the eighteenth century. The American people don't want the metric system and the people can not be compelled to accept this futile thing, for they have the power to elect a Congress that will respond to the concensus of public opinion upon this great question.

The English language, English law, and English measures are the heritage of the people. They are the common language, the common law, and the common measures of the country. They exist by inveterate custom and universal consent. And they exist independent of the force of any statute or enactment of legislation. They are not to be abolished by arbitrary statutes. It were futile to attempt it, because the country will not have it, and the will of the country will ultimately govern in this matter.

The greater the fallacy, the greater the number of volumes that may be printed about it. Thus the literature of metricism is second only to that of socialism, single taxism, and of other fallacies which never lack adherents and advocates. It may be said that all fanatics are sincere, the metric fanatics with the rest. Sincerity, indeed is the most invariable quality of fanaticism. Sincerity, zeal, and assiduity are, therefore, not to be taken as proofs of the soundness of any cult, cause, or propaganda.

It is said by some that the metric system is inevitable and that its adoption would otherwise be a desirable thing for the country. The truth is that the metric system is neither inevitable nor desirable. There are, moreover, no adequate or even any sound reasons, and certainly no advantages, for its adoption in a great commercial country like the United States. The more the matter is examined the more the reasons multiply which interdict its adoption. There is nothing behind this metric movement but the stimulation of artificial propa-

ganda. If the propaganda would stop, the whole scheme would die down and die out. It has utterly no vital force of itself. Outside of the few zealots who either from motives of pay or passion, carry on this agitation, the great mass of emotionalists who have given a nominal indorsement to the metric scheme, are in fact indifferent about it and respond only to artificial stimulation. I dare say that many of these indorsers of the metric system, such as the World's Sunday-School Association and the International Sunshine Society do not know a centimeter from the side of a barn, and have merely reacted in an emotional way to the stimulation of the propagandists.

In linear measures the metric system offers us nothing between the centimeter of about two-fifths of an inch and the meter of 39.370113 inches. In other words, the metric system offers us centimeters instead of the inches, feet, and yards to which we have become accustomed, and which we have adopted because of the practical magnitude of these units for customary use and application. If we were to go about with microscopes over our eyes, and were to live in the realm of the invisible and infinitesimal, we might see things in the metric system. But as practical men we can not see the metric system at all. The following simple table of the primary units of our common system and the multiplex metric values with which they would have to be replaced for ordinary use, demonstrates that the practical thing for the people is to leave metric measures absolutely alone.

1 inch	millimeters	25.4	1 fluid ounce	milliliters	28.35
1 foot	do	304.8	1 quart	do	946.4
1 yard	do	914.4	1 pound	grams	453.6
1 ounce	grams	28.35	1 bushel	liters	352.24

No one but a very simple person would in the face of these plain facts say that the metric scheme would simplify our present measures or would be of any advantage or utility in the daily transactions and affairs of the people. And this is the impractical thing which a relatively small number of persons who are dominated by the idea that any change is progress want to foist upon the unsuspecting people of the country.

I have looked over the printed testimony presented in favor of the pending compulsory metric bill. To one who is acquainted with the iterations and reiterations of metric propagandists there is nothing new in the testimony presented to the committee. Metric propagandists all say the same things. They sing the same song and seem to be entranced with the sound of their own voices. They make no point that can not be answered and completely answered. I presume that this has been done by the gentlemen who have appeared against the pending measure. I only desire to advert to one or two points in the testimony.

The witness, William J. Schieffelin (pp. 10, 11, and 12), propounded certain arithmetical problems which he claimed demonstrated the greater facility of computation in the metric system. He admits there is nothing on this point in his first example. In his second example he claims that 1 pound, 3 ounces, and 237 grains may be more easily written as 554 grams. It could quite as easily be written as 19.542 ounces. In his third example he claims that 13 pounds, 12 ounces, and 311 grains could be more easily written as 6.256 kilograms. It could quite as easily be written as 168.711 ounces. In his fourth example he claims that 5 pounds, 9 ounces could easily be written 2.523 kilograms. It could quite as easily be written as 89 ounces. His fifth, sixth, and seventh examples merely present examples of writing weights given in pounds, ounces, and grains avoirdupois, claiming that it is simpler to state these weights in grams.

We have only to state these weights in ounces and decimals to obtain all the facility of writing and all the facility of computation and the facility of weighing which is claimed for the gram and its decimal divisions. In practice the ounce is not divided into grains, but into halves, quarters, eighths, tenths, hundredths, and thousandths, and weights in these denominations, for use on balances, are now offered to the trade. Example 7 requires the multiplication of a quarter of a grain to 10,000 times. This problem merely requires that the quarter grain be expressed in thousandths of the ounce and multiplied by 10,000, the result or product by the proper placing of the decimal point being in ounces and decimals. Example 8 requires the multiplication of 1½ grains by 36,000; 1½ grains are .00342 ounce, which multiplied by 36,000 gives 123.12 ounces. And there is nothing incongruous in not converting the ounces into pounds. In dealing with gold and silver multiples of the Troy ounce are used without reference to the Troy pound at all. In the assay office at New York I

have seen a 500-ounce brass block, and also brass blocks of an hundred ounces and of other large multiples of the ounce, for use in weighing gold bars and bullion. If for convenience, in laboratories or otherwise, it is not desired to convert ounces into pounds, this need not be done. Examples 9 and 10 are merely repetitions of the same principles and need not be especially considered.

Decimal weights of the half (500), quarter (250), eighth (125), tenth (100), hundredth (10), and thousandth (1) of the ounce may be obtained of Henry Troemner, Philadelphia. Balances with beams graduated to measure tenths and hundredths of the ounce may also be obtained from Troemner, of Philadelphia. Modern scales with charts graduated to ounces, such as the 5-pound or 80-ounce candy scale sold by the Toledo Scale Co., may readily be furnished with a chart graduated to show decimal multiples of the ounce as 10, 20, 30, 40, 50, 60, 70, and 80, with intermediate graduations showing ounces.

Such a chart would, for example, avoid splitting pounds in the retail candy trade and would be generally advantageous for retail trade use. Steel and linen engineers' tapes and mechanics' wood rules graduated to tenths and hundredths of the foot may be purchased of the Lufkin Rule Co., of Saginaw, Mich.; the Stanley Rule Co., of New Britain, Conn.; the L. C. Starrett Co., of Athol, Mass.; the Brown & Sharpe Co., of Providence, R. I., and other manufacturers. Decimal scales of the foot, graduated to tenths, hundredths, and thousandths, and figured to tenths or hundredths, may be purchased from Theodore Alteneder & Sons, of Philadelphia. The facilities for the decimalization of the foot and of the ounce and for the practical decimal use of the foot and the ounce, are now available to the trade and to the public.

Mr. Shieffelein presents, on pages 14, 15, and 16 a list of alleged organizations which he says endorse the metric system. It is significant that the so-called World Trade Club, which has covered the United States, Canada, and the British dominions with its fictitious propaganda in favor of the metric system, is omitted from this list. It is this so-called club, which is merely a privately owned and operated propaganda agency, which has exploited the false claim that James Watt invented the metric system, and that George Washington, Thomas Jefferson, Benjamin Franklin, and John Quincy Adams approved and indorsed the metric system. These claims are utterly without foundation and their dissemination is merely a scheme of systematic deceit. It is to be noted that these clumsy contentions have not appeared in the testimony offered in the pending hearings, although the agents of the World Trade Club have had direction of the case for the metric system. This represents a distinct yielding of ground by these metric propagandists.

Mr. Elwood Haynes in his testimony made one significant admission, and that is that "we sometimes call the metric system the centimeter gram system." That is what it really is. It ought to be called the centimeter system and not the metric system. The whole thing is incorporated in the cubic centimeter, which is a little cube about the size of the dice used to "shoot craps." These are wonderful little things; one of them will displace a gram of water, and they may be loaded so as to "come 7 or 11" at every throw. That is the beginning and the end of the metric system. Mr. Haynes, on page 20, propounds a problem of computing the cubical contents of a round tank 20 feet in diameter and 7 feet in depth. The factors being stated in foot units, the computation is simple enough, and by the application of the regular formula the contents are found to be 2,200 cubic feet. Mr. Haynes then proceeds to explain how this volume is converted into pounds, or gallons, or barrels of water, and expounds the different processes. He states that if the tank were 4 meters wide and 7 meters deep he would by the same formula find that the volume would be 88 cubic meters, which he translates into 88,000 liters or 88,000 kilograms. To convert 2,200 cubic feet to pounds, Mr. Haynes multiplies by 62½ the number of pounds in a cubic foot of water; 62½ pounds are precisely 1,000 ounces. So we may write 2,200 cubic feet 2,200,000 ounces, which is quite as simple as writing 88,000 liters, 88,000 kilograms. The arithmetical process is the same. And there is really no advantage in converting cubic feet into gallons or barrels. Water in reservoirs is now measured by cubic feet and acre-feet. Water is sold through service mains by the cubic foot, gas is sold by the hundred cubic feet. Moreover, Congress has laid the tariff duty on oranges, lemons, and grapes imported from abroad, at a certain rate per cubic foot of the capacity of the containers.

The capacity of any container, from orange boxes to cargo space in ships may be readily computed in cubic feet by taking the dimensions in feet and

decimals, as are shown by any engineer's decimal tape. The number of cubic feet is the weight of water in thousands of ounces. Knowing the specific gravity of the material or substance to be contained, we have only to multiply the cubic feet by the given specific gravity to obtain the weight of the material from its measured volume. It would be a simple matter to denominate a new thousand-ounce weight unit and to give the ounce and fluid ounce volumetric definition and correlation which would afford us all the advantages claimed for the metric system in the conversion of volumes into weights. We can completely meet and satisfy the requirements of decimilization, of correlation of the units, and of standardization without adopting the impractical and indeed impossible metric system in this country. The foot has become the dominant linear unit. In America, at least, the foot is not regarded as a fraction of the yard, but the yard is rather regarded as a multiple of the foot. The proper program, therefore, is to have a standard decimalized foot, just as we have a standard decimalized dollar.

Mr. Eugene C. Bingham, a witness for the metric system, made the grotesque claim that the "farmer goes to school in the first place as a boy and struggles over his arithmetic, and that it has been calculated in this country that there will be a saving of a million years in one generation if we adopt the metric system." (Hearings, p. 53.) One can not have patience with such fantastical nonsense as this. What boy could be called educated who had not been trained in the use of the common or vulgar fractions, or who could not divide and multiply by 3 and 4 as well as by 2 and 5, or who did not understand halves, quarters, eighths, sixteenths, and thirty-seconds, and thirds, sixths, twelfths, twenty-fourths, and forty-eighths?

What boy could be expert in mental arithmetic who could not use common fractions with facility and celerity? Of all the sentimental piffle that has been advanced in favor of the metric system, this claim of saving time of students in the schools is the limit of absurdity. Boys spend years of their school courses in the mastering of algebra and geometry and of Latin, in order to acquire mental discipline, mental accuracy, and logical processes of thought. And yet there are those who claim that the spending of a little time in the mastering of common fractions and of the ordinary elements of arithmetic is an onerous and detrimental task to be imposed upon a boy who is having his mind trained in the schools. It is a wonder that they do not tell us how many millions of dollars may be saved in the annual cost of teaching arithmetic by the metric system. The common people understand common measures. The carpenter, the machinist, the bricklayer, the surveyor, the farmer, the merchant, those who buy and sell in the markets, understand the measures which are in common use, and they understand also that they do not want to understand the metric system, and that they want to leave the thing alone absolutely! In the great and dominant fields of food production, house construction, and textile fabrication there will never be any place for the metric system. The country, moreover, has no intention to measure our great grain crops of corn, wheat, and rye in quart cups, and has less intention to measure them in liters, and I want to tell the metric zealots that it will never be done.

Mr. Bingham (hearings, p. 55) claims that any person who could read or write could be taught the metric system in half an hour. Another witness gave the time as 15 minutes. Well, the metric system was defined by an act of Congress more than 55 years ago, and the country had ample time to make up its mind that it does not want the thing and will not have it, and there are plenty of us who do understand the metric system, who know quite well what the system is, and to put the case bluntly, know that the thing is of no practical utility after you do understand it, and it is certain that the great mass of the people will come to the same conclusion if the case be fairly presented to them.

The metric particans ought to be satisfied with the present situation.

The metric system has been defined by a law. There is really no room for two official systems in the country. Instead of attempting to interdict the use of the English system by law it were a great deal more sensible to interdict the use of the metric system by law. But such drastic action is not necessary. The present legal toleration of the metric system is as far as the law should go. In answer to the absurd proposal of having a world pound, a world yard, a world quart, a world foot, a world inch, and a world bushel, defined in terms of the metric system, we have only to say that the English pound is now the world pound, the English yard is now the world yard, the English quart is now the world quart, the English foot is now the world foot, the English inch is now

the world inch, and the English bushel is now the world bushel, and the world will have no other pounds, yards, quarts, feet, inches, or bushels, certainly not of the metric mongrel variety. If this statement is not entirely true let us make it true. Any slight variation between the American and English measures should be accommodated and our common system should be simplified and coordinated to meet every requirement of commerce and the arts. Metricists propose to compress the English foot to 30 metric centimeters. It would be a great deal more practical to expand 30 centimeters to equal a foot, which only means the increase of a centimeter from .0328 to .033 feet. If there is to be coordination this is the only way to have it.

I need not refer to the very illuminating testimony of the naval officers and Army officers which was submitted to the committee. For straightforward, sound thinking, this testimony stands in clear contrast to the emotional and sentimental vagaries of the metric witnesses who appeared before the committee. There is nothing that I can say which will add to the weight of this expert testimony, but I would like to be permitted to commend it to the committee as worty of all credence and approval.

I did not hear any of the testimony of these witnesses except that of Dr. H. W. Wiley. I happened in the room at the time he was testifying. The doctor, as he says himself, as long ago as 1873 published a paper advocating the adoption of the metric system. He confesses that he has spent his life in metric preoccupation, not to say propagation. He sees everything with the eyes of a metricist, and yet he frankly says that without drastic action by Congress it will take 50 or 100 years to bring the metric system into common use. I think myself that the doctor is very optimistic as to the time it will require to make the metric system common or vulgar. The doctor repeats this argument about saving the time, health, and mental equanimity of the school children. He thinks that 15 minutes would suffice to teach a boy the metric system. He expatiates upon the sweet simplicity of milli, centi, and deci, and of deka and hecto, and kilo of the meter family, but after telling us of the attractiveness of these delectable creatures, he says (p. 133), "But let us keep our quarts and pounds and gallons and yards. Do not let us scrap our names." Just say that a pound is 500 grams, and a quart is a liter, and a yard is a meter, and we will be happy in the delusion that we are still dealing in these good old homely measures. It is remarkable to what painful lengths the metric propagandist will strain to popularize his peculiar cult.

The doctor submitted a table of the number of pounds per bushel measure, of plastering hair, hemp seed, flaxseed, grass seed, malt, onions, peaches, pears, popcorn, potatoes, sweet potatoes, corn on the cob and corn unhusked, corn meal, oats, dried peaches, salt, tomatoes, and turnips, in the various States, the inference being that in some indefinable and providential manner these imperfections and variations would all be rectified by the metric system.

Such a contention, whether it be made overtly of by inference, will not bear a moment's examination. No one can contend that the mere substitution of hectoliters, which have the impractical volume of about 3 bushels, for the bushel measure, of practically 1¼ cubic feet, will assimilate these inequalities. The doctor's tables may constitute an argument for the selling of these commodities by weight, instead of by volumetric units, but that can be perfectly accommodated by the use of pounds instead of bushels. Certainly no practical man wants to play with the kilogram like a faddist, instead of using the pound and its decimal multiples, hundred pounds and thousand pounds, as is the custom of trade to-day.

The doctor says that there are boys and girls spending not only hours but months learning a complicated system which no human ingenuity can comprehend and are sapping their vitality in so doing. I suppose the doctor thinks that the boys and girls ought to put in their time learning millimeters, milliliters, kilometers, decaliters, hectoliters, deciliters, centiliters, centimeters, decimeters, decameters, hectometers, milligrams, centigrams, dekagrams, hectograms, kilograms, and myriameters, all of which is about as interesting as the study of the Greek nomenclature for bugs and for the prehistoric dragons.

The doctor grew eloquent in denoting the nickel jitney (p. 125) as the most valuable coin ever struck from the mint. He says it weighs 5 grams and you can weigh things with it. Of course, if you had 91 of them you could weigh out a pound, but who wants to carry around a pound of nickel or iron in 5-gram slugs to use on the balances that may weigh the things he buys? The doctor, moreover, says "the diameter of that nickel is almost a centimeter" and "you could put them together that way and measure distances

with them." The dimensions of the Capitol Building could be measured by laying out nickels end to end, but what would be the use? But the doctor is mistaken as to the diameter of the nickel.

The diameter is not 1 centimeter, as he says, but 21 millimeters, which is 2.1 centimeters. The metricists are certainly hard up for an argument when they talk about the diameter of the nickel as a point for the metric system.

The doctor says that "I have studied this problem for a lifetime or more of most people, and every time I turn my attention to it I find some additional reason for favoring this proposition." I may be permitted to say, on the other hand with due humility, that I have studied the metric system within my limited years and every time I turn my attention to it I find some additional reason against the proposition. A thing that is wrong, intrinsically wrong, is, of course, wrong from every angle, and the more views you get of it the more the fallacy of the thing is manifest.

One of the most far-fetched metricist claims is that advanced by Ben C. Dailey, "president" of the World Trade Club, in his statement on the Ladd metric bill (hearings, p. 146), namely, that this metric bill has some intimate relations with the Limitation of Armament Conference now in session in this city. This witness went so far as to say that if we had had the metric system the Kaiser would never have dared to declare war (p. 147). Of all the sickly sentimentality that is indulged in by metric zealots this claim that the metric system has anything to do with peace or disarmament is the limit of gratuitous assumption. The peace of the world in the present posture of international affairs depends upon the unity of English-speaking peoples and the spread of English liberty, English letters, English law, and English measures throughout the world. And the duty of the American people is to retain inviolate our Anglo-Saxon heritage, both for ourselves as well as for the benefit of all the nations, and for the expansion of trade and peace throughout the world.

And as for the metric system, let us consign it to innocuous desuetude.

The CHAIRMAN. Mr. Dale, do you want to be heard?

Mr. DALE. It is my purpose to present to the committee a written brief.

The CHAIRMAN. It is understood, then, that your paper will be furnished to the committee by January 15, and will be printed in the record at this point?

Mr. DALE. Yes, sir.

(The statement is printed in full, as follows:)

BOSTON, MASS., *January 14, 1922.*

Hon. CHARLES L. MCNARY,
Chairman Subcommittee of Committee on Manufactures,
The Senate, Washington, D. C.

SIR: During the hearings on the metric bill (S. 2267) three methods have been proposed for introducing the metric system into the United States on the assumption that its introduction is desirable:

(1) By popular education leading the States to adopt laws imposing this system upon the people.

(2) Enforcing the system in all governmental activities, setting an example for all of us to follow.

(3) Forcing the people to use the new system, as this bill (S. 2267) proposes to do.

EDUCATING THE PEOPLE.

There has never been any popular demand for a change to the metric system in the United States. Following its establishment in France during the French Revolution, the metric sustem, then new and in its experimental stage, was repeatedly brought to the attention of Congress, not by a popular demand but by individuals. In 1817 the Senate directed Secretary of State John Quincy Adams to prepare a report on the weights and measures in the several States and in foreign countries with a view to the fixing of standards for the United States. After nearly four years of patient investigation, begun with a predilection in favor of the metric system, Adams submitted his report on February 22, 1821, in which, after discussing all sides of the question with extraordinary ability, he recommended that no change in the existing English weights and measures be attempted.

Adams's report, revealing so clearly the insuperable difficulties of changing our weights and measures even at that early stage in the development of the

country, put an end to the metric agitation, which was not resumed until nearly 40 years later in the late fifties by scientists, school-teachers, and a few Government officials, but with no popular demand back of it. At the close of the Civil War a bill, making the use of the metric system compulsory, was introduced in the House of Representatives, but was amended so as to make the use of the metric system permissive. Charles Sumner, who shared the enthusiasm of scholars, scientists, and Government officials over the assumed merits of the metric system, said in his discussion of the bill in the Senate:

"By these enactments the metric system will be presented to the American people and become an approved system of commerce. It will not be forced into use, but will be left for the present to its own intrinsic merits. Our arithmetics must explain it. They who have already passed a certain period of life may not adopt it, but the rising generation will embrace it and ever afterwards number it among the choicest possessions of an advanced civilization."

The bill became a law on July 28, 1866, and its supporters began enthusiastically to bring about a fulfillment of Sumner's prophecy. A campaign of education was carried on in the press, on the platform, and in the class room, the arithmetics explained it, the schools taught it to the rising generation, instilling into the receptive minds of the children the belief that the metric system was perfect and that it was sure to come into universal use, displacing all other weights and measures. But when the boys and girls left school in the seventies and eighties they quickly forgot nearly all of the little they had learned about the metric system, being compelled to use the English weights and measures by which the work of their country was carried on.

Under the influence of this failure of the metric dream of 1866, the teaching of the metric system in the schools was gradually abandoned until about 1900. At the end of a third of a century it had shrunk to the negligible proportions in which it is found in the schools to-day. The campaign of education in the elementary and high schools begun in 1866 and carried on so enthusiastically is found at the end of 55 years to have been a complete failure. With this expereince as a guide, there is not the slightest ground to expect that a like experiment begun in 1921 would result in anything but an early and complete collapse in the extremely improbable event that it could be even started. It has been demonstrated that the first method of bringing the metric system into use is out of the question. This demonstration was unnecessary. The notion that the established weights and measures of the country can be changed by boys and girls fresh from school is a self-evident absurdity.

FORCING THE METRIC SYSTEM ON THE GOVERNMENT.

The second method proposed for introducing the metric system into the United States consists in making its use compulsory in all the departments of the Government with the expectation that this will lead to its adoption by the people. Three quesions arise in is connection: (*a*) How would such compulsory use affect the Government service? (*b*) How would it affect the people outside of the Government service? (*c*) To what extent would the compulsory use of the metric system by the Government lead to its adoption by the people?

If you committee has any doubt as to the inadvisability of this step, I suggest that the heads of all of the executive departments of the Government be requested to report to the Senate what objections there are to making the use of the metric system compulsory in all governmental transactions requiring the use of weights and measures, to what extent the compulsory use of the metric system by the Government would lead to its voluntary use by the people, and to report on any objections that may exist to having one system of weights and measures used by the Government and another and incommensurable system used by the people.

While such an investigation would be a valuable guide, it is by no means essential to reaching a decision on this phase of the proposition for compulsory metric legislation. We can apply reason and common sense to the problem, and we can learn from the experience of other countries where this experiment has been tried.

The functions of government have become so extensive and complicated that the proposal to change the weights and measures involved in all governmental activities is far beyond the power of the mind to comprehend in its entirety. We can, however, select isolated applications of weights and measures in Gov-

ernment work and study there the effects of the proposed change. I shall give a few illustrations of the problem to serve as suggestions to your committee.

Weights and measures are as essential in the work of the legislative branch of the Government as is the English language itself. Congress is now engaged in revising the tariff. In order to understand the tariff rates and classifications and to make intelligent comparisons between the tariff schedules of the past and those proposed for the future, it is essential that the legislator shall be familiar with the units of weights and measures on which past and proposed rates are based and to discuss these schedules with others in official and private life who speak the same language of length, area, volume, and weight. This essential uniformity will be lost if the metric system is made compulsory in public business.

Take, for example, the intricate textile tariff schedules. Even those who have been engaged for years in the textile industry find great difficulty in tracing their way through the mazes of the linen, cotton, wool, and silk schedules when they are based on the familiar English weights and measures. What hope would there be for any comprehension of these schedules by legislators if the yard, foot, inch, pound, and ounce are abolished, and in their places the lawmakers find the strange and incommensurable meter, centimeter, millimeter, kilogram, and gram. The public generally would be in a darkness much deeper even than what has prevailed in the past regarding these schedules. A clear comprehension of the meaning of the proposed rates and classifications would be confined to a very few who, either from self-interest or personal inclination, might apply themselves to an intense and special study of the metric tariff. What an opportunity such a situation would offer to the framers of tariff "jokers."

Another department of the Government in which weights and measures are in constant and extensive use is the Bureau of the Census. A change from the fundamental English standards to the metric would at one stroke make it impossible for either the officials or the public to compare the statistics of the metric census with any of the census reports that have been compiled since the first European settlements in America; it would make every part of the United States census based on weight or measure incomprehensible and worthless, besides increasing enormously the cost of collecting and compiling statistics obtained from 100,000,000 people who use the English system.

Under a law making the metric system compulsory in Government business the survey of the public lands and all official connection with real estate, now based exclusively on the familiar units, the township, square mile, acre, rod, chain, link, foot, and inch would necessarily be based on metric units that are incommensurable with these English standards. The dimensions and areas of parcels already laid out could never be changed. Imbedded in Government records, recorded at county seats in all the States, the familiar and convenient expressions of these dimensions would have to be abandoned for unfamiliar and awkward expressions involving long and clumsy decimal fractions of the metric units—the kilometer, meter, decimeter, centimeter, are, hectare, and centare. New surveys and plotting of land by the Government would naturally be based on integral metric units. And thus the compulsory metric law would at one stroke establish for all future time the confusion of three distinct systems of measurement: (1) The English system, which could not be separated from the dimensions and records of land already surveyed and divided; (2) the system of expressing the English dimensions in awkward metric equivalents; (3) the metric system used for new surveys. In this connection I will quote the following statement by J. E. Hilgard, assistant, United States Coast Survey, and inspector, United States standard weights and measures, who in response to a resolution by the House of Representatives submitted a report dated March 21, 1878, on the obligatory use of the metric system for Government business:

"Not only are lands purchased from the public domain described in a simple decimal system of acres measured by square chains and decimals, but all the most valuable real estate, such as lots and streets in cities, has been laid off in this country in even feet, generally even tens of feet, as 50, 60, 80, 100, 150, etc. What adequate motive is there to change these expressions into terms which are necessarily fractional and in which those foreign nations whose convenience it is proposed to meet have no conceivable interest? What useful purpose is subserved by designating a building lot 24 by 120 feet in the form

of 7.315 by 36.576 meters? It is the foregoing and similar considerations which lead the undersigned to doubt whether the international units of measure will ever wholly take the place of all others in our domestic transactions."

In this connection the recent experience of the United States Army is of interest. It led to United States Army Order No. 26, dated May 3, 1920, issued after the War Department has given long and careful consideration to the proposal to use metric weights and measures in the military service of the country, whose fundamental system is English.

"*Units of weight and measure for the Army.*—As an incident to the World War, metric units of weight and measure were necessarily used in instruction and training. As a result more or less confusion now exists as to what units should be used normally.

"Hereafter the customary British units of weight and measure (including the degree Fahrenheit) will, as far as practicable, be used throughout the Army as they were before the World War."

These four illustrations, relating to the revision of the tariff, the compilation of the census, the survey of land, and the military service, important as they are, are but suggestions of the stupendous array of difficulties and the indescribable confusion that would result from the compulsory use of the metric system by the Government of the United States.

These conclusions are confirmed by the experience of other countries in which the metric system has been first forced on the departments of the Government. I will submit evidence as to a few countries, which could be extended indefinitely:

Salvador: "Metric system has been obligatory in official and Government usage since January 1, 1886. Effort has also been made to popularize the metric system, but other units are still in common use among the people." (Vice Consul Franklin, San Salvador, Jan. 9, 1920.)

Nicaragua: "The metric system is the official and lawful system of the Republic. Owing to the preponderance of trade with the United States, the influence of the system obtaining there is felt in all commercial transactions. All imports are based on the kilo, but throughout the Republic articles are retailed by the pound. Liquids when imported are measured by the liter, yet the American gallon and quart are commonly known. Distances are computed in kilometers, but the yard of 36 inches is used almost as much as the Spanish vara, or the meter." (American Consul McConnico, Corinto, Feb. 20, 1918.)

Panama: "While the metric system is the official standard for the country, it is seldom used in Panama except for land, the American (English) standards of weight and measure being in universal use." (American Consul General A. G. Snyder, Panama, Mar. 22, 1918.)

Peru: "From July 28, 1869, the metric system has been used in all of the public offices of the Government, but the commercial houses still used the old Spanish system of weights and measures until the municipal council of Lima, on April 12, 1916, ordered that all commercial firms use the metric system. If they did not do so, they would be fined several times, after which their business licenses would be canceled." (American Vice Consul James H. Roth, Lima, Nov. 7, 1919.)

"In Peru, where the metric system has been recognized as the legal system since 1866, it can be stated that the official intervention alone has been effective, and this in an intermittent manner at such time as the confusion caused by the use or abuse of heteregeneous weights and measures has created a pernicious system actually alarming." (Carlos Basadre, Mechanical Engineer, Lima, June, 1920.)

The lessons of experience are in accord with the teachings of reason and common sense. To force the metric system on the officials of the Government results in obstructing and confusing the public service, involves the weights and measures of the people in confusion, adding an official set of standards to the established system with all the evils of a dual system, increasing the use of the new standards only so far as compulsion in Government business extends to the individual, but failing to change the standards of the people by the power of official example. Like the first project to teach the metric system to the children in the schools that they may change the fundamental weights and measures of the country when they go out into the world, this second scheme to lead the people by governmental example to change their habitual methods of weighing and measuring is a failure as a means for displacing the English system in the United States.

FORCING THE METRIC SYSTEM ON THE PEOPLE.

To change weights and measures of the United States from the fundamental English standard to the metric system, the Government must do two things: (1) Prohibit the people from using the English weights and measures; (2) compel the people to use the metric weights and measures. The first question to present itself in the consideration of this undertaking is whether Congress has the power under the Constitution to prohibit the use of our English weights and measures. On this point I will submit an extract from an opinion given in 1903 in connection with two metric bills before the House of Representatives by that distinguished lawyer and statesman, the Hon. P. C. Knox, at that time Attorney General of the United States, and whose earthly career was brought to a sudden end but a few months ago:

"The terms, figures, and characters in common and almost universal use in our system of weights and measures are just as much parts of the English language as is any other portion of that language, and to forbid to the people their use would require as clear an expression of the legislative will as it would to forbid the use of that language in other matters, even if that would be effective. It may well be doubted if it would be within the competency of Congress to forbid to the people, for this or for any other legitimate purpose, the use of this or any other portion of the language in which our Constitution, our laws, and our literature are written and in which we orally express our thoughts and feelings. I am of opinion that neither of the bills referred to if enacted into law would at all affect the legality or validity of any contract thereafter made because expressing its stipulations as to weight or measure in terms other than those of the metric system."

Waiving for the present the question of the power of Congress under the Constitution to prohibit the use of English weights and measures, let us consider some of the probable effects of the pending bill (S. 2267) providing Congress undertakes to force the people to use the metric system.

The first and decisive fact we encounter when viewing the problem from this standpoint is that whatever may be the constitutional authority of Congress to enact the law, the executive department of the Government charged with the duty of enforcing the statute will face a power far greater than the officers of the law can summon to their aid.

Weights and measures are rooted as deeply into the life of the people as is any institution in our social organization. Language in this respect does not surpass them, because weights and measures are themselves an essential part of our language and, furthermore, are fixed irrevocably in the dimensions of the varied and complex products of modern arts and industries. The applications of weights and measures are without number; the complexities involved in a disturbance of established weights and measures are unlimited. The subject of weights and measures is so vast that, like astronomical distances, the mind can get no comprehensive grasp on its ramifications.

Important as may be the study of weights and measures as used in even the most extensive of special fields, such partial consideration of the subject serves only to obscure the problem as a whole. I might go into a detailed discussion of the technical applications of weights and measures in tetxile manufacturing, with which my experience has made me familiar. Others could submit like discussions of other special fields. But even to those who have studied the subject as specialists and to a far greater degree to those who are not versed in the technicalities involved, this treatment of the weights and measures question serves only to confuse its broad and essential features. So, instead of viewing the problem from the standpoint of the specialist, I will by a consideration of some of the broader aspects of the proposition show how far a change of our English weights and measures lies beyond the limits of the possible.

As a preparation for this we can not do better than recall the words of Secretary of State John Quincy Adams in his report on weights and measures, prepared at the request of the Senate and submitted in 1821, just 100 years ago. Contemplating the proposal to make the metric system compulsory in the United States, Adams said:

"The substitution of an entire new system of weights and measures, instead of one long established and in general use, is one of the most arduous exercises of legislataive authority. There is indeed no difficulty in enacting and promulgating the law; but the difficulties of carrying it into execution are always great, and have often proved insuperable. Weights and measures may be ranked among the necessaries of life, to every individual of human society,

They enter into the economical arrangements and daily concerns of every family. They are necessary to every occupation of human industry; to the distribution and security of every species of property; to every transaction of trade and commerce; to the labors of the husbandman; to the ingenuity of the artificer; to the studies of the philosopher; to the researches of the antiquarian; to the navigation of the mariner, and the marches of the soldier; to all the exchanges of peace, and all the operations of war. The knowledge of them, as in established use, is among the first elements of education, and is often learned by those who learn nothing else, not even to read and write. This knowledge is riveted in the memory by the habitual application of it to the employments of men throughout life. Every individual, or at least every family, has the weights and measures used in the vicinity and recognized by the custom of the place. To change all this at once is to affect the well-being of every man, woman, and child in the community. It enters every house, it cripples every hand."

AN IMPOSSIBLE TASK.

With this picture of the problem before us, let us try to form some idea of the task before the Government that undertakes to change by a compulsory law the weights and measures of the American people in 1922. Approximately 41,000,000 are engaged in gainful occupations. The strong arm of the law must reach out and change the established standards of measurement now used by 15,000,000 people engaged in agricultural pursuits; by 8,000,000 rendering domestic and personal service, of which 800,000 are servants and waiters; by 10,000,000 occupied with manufacturing and mechanical pursuits, of which 2,000,000 are in the textile trades, including besides the mill workers, dressmakers, tailors, seamstresses, etc.; by 1,700,000 in the building trades; by 1,700,000 in the metal-working trades; by 500,000 in the lumber industry, and 420,000 in the manufacture of leather products; besides 1,700,000 rendering professional services.

Nor is this all. Of the remaining 59,000,000 all over 10 years of age are using weights and measures in some form, and the law must change their habits of measurement. All this must be done suddenly or not at all in order that each individual starting out to measure and weigh by the new system may find all with whom he or she comes in contact ready to measure and weigh by the same standards. All the ingrained ideas of dimension and weight now possessed by 100,000,000 people, increasing at the rate of 4,000 per day and scattered over an area of 3,600,000 square miles, are to be suddenly changed to new standards, all records of weight and measure are to be relegated to the position of a foreign language to be used only by translation into the new tongue, and all of the innumerable dimensions and weights with which the people constantly deal are to be expressed, not in the terms with which they have been familiar from childhood, but in terms of new units with which all but a very few are now wholly unacquainted.

To contemplate in its broader aspects a change of the established weights and measures of the United States is to recognize the everlasting impossibility of the undertaking; it is to recognize that whatever may be the constitutional authority of Congress to enact a compulsory metric law, the executive department that undertakes it will come in conflict with a power greater than that possessed by any Government, the power of inveterate habit of millions of people in their individual and associated activities. The Members of Congress and the President have the power to enact a compulsory metric law, but neither they nor the people on whom they impose the law have the power to obey it. Referring to a change of weights and measures by law John Quincy Adams said:

"The power of the legislator is limited over the will and actions of his subjects. His conflict with them is desperate, when he counteracts their settled habits, their established usages, their domestic and individual economy, their ignorance, their prejudices, and their wants; all which is unavoidable in the attempt radically to change, or to originate, a totally new system of weights and measures."

In viewing the problem from this angle, I have necessarily assumed that the forcible change of our established standards is to be undertaken by a Government capable of exercising autocratic power for an indefinite period. But fortunately we do not live under such a Government in the United States. Here the ballot gives to the people the power by orderly and lawful means to shape

the policies of the Government, including the control of weights and measures. The proposal to compel the people of the United States to abandon their ingrained system of weights and measures and adopt an unknown system means that the self-governing people of this country are to impose this revolution on themselves. Viewed in this light the metric proposition becomes grotesque in its absurdity.

PARTIAL CHANGE AND DUAL STANDARDS.

While a complete change from the English system to the metric is impossible by any of the three methods—popular education, use by the Government, and outright compulsion of the people—it is possible to force the metric system into the United States by degrees, and in this way gradually involve the people in the confusion of two incommensurable systems of measurement. There is probably no one who will not agree that such a mixture of two standards of weight or measure is an unmitigated evil. Regardless of its merits or defects, any one system of weights and measures is far better than any two.

It is not necessary to multiply illustrations of the burden involved in the use of multiple standards. A few will illustrate the inherent evil of all. The natural and most convenient method of measuring and weighing is by whole numbers and convenient fractions. When a new and incommensurable system like the metric is introduced, the difficulties involved in suddenly changing from whole numbers by the old system to whole numbers by the new leads to a compromise by which the old units continue to be used, but expressed in equivalents by the new standards, involving extremely awkward fractions. This is not using either system; it is misusing both. The pound is now divided into the convenient 16 ounces; by the metric-equivalent scheme, which has been advocated by some of the supporters of this bill (S. 2267), the pound becomes 453.6 grams. The inch is now ordinarily divided into halves, quarters, eighths, sixteenths, thirty-seconds, tenths, hundredths, and thousandths; the metric-equivalent scheme makes the inch equal to 25.4 millimeters. The yard is commonly divided into halves, quarters, eighths, sixteenths, tenths, hundredths, and thirty-sixths; the metric-equivalent scheme converts it into 914 millimeters. Compound units when subjected to the metric-equivalent scheme show even more objectionable effects. The standard of 840 yards per pound is now the world standard for converting cotton into yarns and fabrics; the metric-equivalent scheme converts this convenient standard into different forms—into 768 meters per 453.6 grams; into 768 meters per English pound; into 1,693 meters per kilogram; No. 1 English becoming No. 1.693 metric.

These illustrations can be extended indefinitely. Nor is this the worst of it. Not only are the old units expressed in equivalents by the new system, but the new units are expressed in equivalents by the old system. The kilogram becomes 2.2046 pounds. The meter becomes 1.0936 yards. The centimeter becomes 0.3937 inch. The metric standard of 1 kilometer per kilogram for textiles becomes 496 yards per pound or 453.6 meters per 453.6 grams, No. 1 metric becoming No. 0.5905 English. And thus by piling reciprocals on top of direct equivalents and mixing them all together weights and measures are thrown into confusion worse confounded that exists in the textile industry of Continental Europe at the present time. The few metric equivalents and their reciprocals given above, bad as they are, are surpassed in awkwardness by an innumerable number resulting from other and common applications of the metric equivalent scheme.

THE CONTINENTAL CHAOS.

There is probably no more convincing proof of the extent of the calamity involved in saddling the industries of a country with the metric equivalent scheme than that found in the textile industries of Continental Europe. Ever since the metric system was introduced there 129 years ago the Continental textile industry has become involved at a steadily increasing rate in the chaos of mutliple standards with their direct and reciprocal equivalents. One has only to examine the textile literature of the Continent to gain an idea of the existing chaos, which has supplied the underlying motive for the continental propaganda to bring about the compulsory adoption of the metric system by the English-speaking world. Unable to rid itself of the metric system, the Continent of Europe seeks escape from or a lessening of the confusion by involving Great Britain and the United States in the confusion of dual systems. The Germans have been the leaders of this metric movement,

but the war has wrecked their hopes of any immediate success from the propaganda. And so in despair they are seeking to simplify the scheme of equivalents by basing them directly on the English standards, the yard and the pound.

Accompanying this brief is a reproduction of an article by E. Roscher, an official in the textile testing house at Zittau, Germany, which appeared in the Leipziger Wochenberichte fuer Textil-Industrie of August 30, 1921. The German official begins by bemoaning the fact that the unfortunate outcome of the war has destroyed all international plans for the unification of textile standards on the metric basis. He then goes on to say that in view of the predominating position of the English standard for cotton, linen, and wool, he has based his simplified plan on the English yard and pound. He then gives tables and calculations, which present a bewildering confusion because of the mixture of the metric system with other units. That article is a statement from official German sources, prepared in an attempt to mitigate the confusion, but in reality it constitutes an unmistakable illustration of the incurable chaos of textile weights and measures of Continental Europe.

A WARNING TO THE ENGLISH-SPEAKING WORLD.

The chaos of weights and measures in the textile industry of the Continent carries a warning to the people, not only of the United States, but of the entire English speaking world, irrespective of the occupation in which they may be engaged, for habits in the use of weights and measures are no more deeply rooted in textile manufacturing than in other occupations, and the abomination of metric equivalents is no greater in the textile mills than on the farm, in the market place or in other workshops and factories.

COMPULSORY METRIC LAW THE SEED OF CONFUSION.

The fact that the metric system can not be made the single standard of the United States by persuasion, official example or force, and that the resort to compulsion, by bringing about the partial use of the metric system, will involve the country in ruinous and incurable confusion, makes it the duty of Congress to restrict the use of the metric system to the narrowest possible limits, and thus, retaining and developing the uniformity we now possess, promote world uniformity on the only basis offering any prospect of success, that of the English system of weights and measures.

As this conclusion holds good whether the innovation consists in the introduction of the metric or other foreign system of weights and measures, and regardless of claims as to any theoretical merits the new system may possess, it follows that the discussion of minor and technical defects in bills to bring about the use of any non-English system is a waste of time, whether it is the Stone, Shafroth, Littauer, Dillon, Frelinghuysen, Britten, Ladd, or other metric bill with its purpose undisguised, or whether it is a metric joker with the same purpose concealed in a Peters-Lodge berry basket bill, a Stratton-Ashbrook-Thurman, Tilson or Clapp weights and measures centralizing bill, a Vestal vegetable basket or other bill whatsoever.

The use of the metric system has been permissive in the United States since 1866. Any additional legislation to further its use is necessarily compulsory. If a proposed bill or a hidden joker is designed to promote the use of the metric system, no matter to how slight an extent, it should be rejected with no consideration, for its purpose is essentially and incurably evil, its effect certain to be the substitution of future confusion for the present incomparable uniformity.

For these reasons I shall spend no time on a criticism or analysis of the Ladd bill (S. 2267), now before your committee. It is unquestionably designed to extend the use of the metric system. For that reason it should be thrown out. And this statement is submitted in order to make plain the reasons why all measures that have the same object should be likewise rejected without consideration. The first and highest duty of Congress in the regulation of our weights and measures is to safeguard the established English standards, preventing all mixtures of other standards with them.

COMPARISON OF THE ENGLISH AND METRIC SYSTEMS.

There are many who waver in their support of the compulsory introduction of the metric system, because of the tremendous difficulties involved, but who are

disposed to believe that the change is desirable because of the superiority of the metric system over the English. This belief in the superiority of the metric system is largely the result of the instruction given in the schools and higher institutions of learning by teachers and professors who have acquired the belief from the same sources. For a number of years after my schooling ending in the 70's, I believed, solely because my teacher had said so, that the metric system was perfect, and certain to become the world's single standard, that the English system was a jumble and doomed to give way before the metric advance. Never having made any independent investigation of the subject, millions of men and women accept the dictum of scientists and educators and remain as ignorant as I was regarding the truth about our weights and measures. It was about 22 years ago while studying the question and searching for evidence to support the bill then before Congress making the metric system compulsory for governmental business that I was compelled by the facts discovered to abandon the belief acquired in school.

For nearly 60 years the schools and colleges have continued to instill in the minds of the young the superiority of the metric system. Evidence of this delusion is found in the reports of the first series of hearings on the Ladd bill. Until it is dispelled by turning on the light of truth the United States will continue to be threatened by the calamity of dual systems of measurement. For this reason I ask every reader of these lines, whether in a position of authority or not, to think for himself, follow the comparison between the English and the metric systems and judge the two without any prejudice that may have been acquired in schools or elsewhere.

The features on which the merits or demerits of a system of weights and measures depend are:

1. Sizes of the units of length, area, capacity, and weight.
2. Names by which the various units are distinguished.
3. Divisions and multiples of the units.
4. Correlation between the units of length, cubic capacity, and weight of that widely distributed liquid, water.
5. Uniformity of usage.

SIZES OF THE UNITS.

We all know that the English units are of convenient size because we all use them. There is a reason for this. Our English weights and measures are the product of natural selection by unnumbered generations. The linear units were undoubtedly derived originally from parts of the human body, which the measurer always had with him, the hand, finger, span, forearm, foot, pace, girth, and stature. Their natural and uninterrupted development can be traced from the dawn of history to the present time. The cubit, half cubit, and double cubit of Babylon, Egypt, and Israel, the foot of Greece, the Roman mile, foot, and inch, the continental pied and pouce, fuss and zoll, the ancient shekel and selah, the Roman libra and ounce, the continental livre and pfund and unze, the correlation between the Babylonian cubic foot of water and 80 Babylonian pounds, between the amphora of 80 Roman pounds and the Roman cubic foot of water, these are some of the links in the chain that connects the English mile, yard, foot, inch, pound, ounce, and the correlation between the cubic foot and 1,000 ounces of water, with the earliest standards of weight and measure that are known to have been used by man.

It has not been the result of chance that weights and measures originating when prehistoric man began to measure and to weigh have been developed through the ages into what is the English system of the present time. The names of the English units prove their prehistoric origin, and their development into a harmonious system can be traced through 5,000 years of recorded history of western civilization in the ordinary occupations of everyday life, in handiwork, in manufacturing, and in the most imposing of human enterprises, in the hanging gardens, walls, and gates of Babylon, the Pyramids of Egypt, the temples of Karnak and Luxor, the inspiring works of Greek art on the Acropolis of Athens, the aqueducts, Appian Way, Pantheon, Coliseum, and St. Peter's of Rome, the cathedrals of the Middle Ages, the architecture of the Renaissance, Westminster Abbey, England's history in stone.

It has not been the result of chance that during the uncounted thousands of years that the English system was being developed in the west, the isolated millions of the Orient developed a system of weights and measures of approxi-

mately the same dimensions as were independently developed in the west. It was not by chance, it was by that wonderful process known as natural selection that weights and measures were originated and have been developed into the English system by which the world's work in all departments of human endeavor is mainly carried on at the present time. It was impossible for units of inconvenient size to be retained by this natural process. It is the operation of this law of natural selection that explains why the English units of weight and measure are perfectly adapted to the work of the world.

The metric units, on the other hand, are the product of an arbitrary scheme devised by a few men with the object of establishing standards that would differ from all the weights and measures that had ever been used before, an attempt by man to improve on the processes of nature. Weights and measures so devised were necessarily of inconvenient size. Starting with the meter the ten-millionth part of the estimated distance from the equator to the North Pole by way of Paris, Dunkirk, and Barcelona, the metric units are divided and multiplied successively by 10. The meter divided by 10 gives the inconvenient decimeter of 4 inches, which divided by 10 gives the equally inconvenient centimeter of four-tenths inch, one-tenth of which is the inconvenient millimeter of one-twenty-fifth inch, the result being three units of inconvenient size in place of two units, the foot and inch, on which the human race in all ages and climes has placed the stamp of its approval. One-tenth of a meter cubed gives the kilogram of 2.2 pounds which, divided by 10, gives the hectogram, and by 10 again the decagram, with no unit of weight to approximate either the English pound or ounce, which, like the English units of length, have stood the test of all human experience since the first moment of recorded time. Among all the metric units, the products of the arbitrary decimal ratio, there are only three of convenient size for the work of the world, the meter, liter, and tonne, approximations of the English yard, quart, and ton.

THE NAMES OF THE UNITS.

It is essential that words in such frequent use as are the names of units of weight and measure shall be short, distinctive by sound and appearance, and derived from the language of the people by whom they are used. These essentials are the characteristics of our English weights and measures, as they are of all other weights and measures of natural origin. Mile, furlong, rod, yard, foot, hand, inch, acre, pound, ounce, dram, grain, bushel, peck, quart, pint, gallon, these are all that names of weights and measures should be, short, distinctive, and English, saving time, preventing confusion in their frequent use, part of the English language itself. Like the sizes, the names of the English units are perfect because they are the product of natural selection. If they had not been what they are they would not have been developed and handed down to us.

On the other hand we find the metric names to be all that such names should not be. They are long, very much alike and derived from two dead languages, Greek and Latin. The inherent defects of the metric names were admitted by the commission appointed from the French Academy of Sciences to construct the system. At that time French weights and measures, derived from the same natural sources as the English, bore names that were short, distinctive, and French. At first the metric commission agreed upon the new and artificial nomenclature, but later when the academy discussed the proposed metric system the commission gave more careful consideration to the new names and, recognizing that their defects were not offset by any compensating advantages, reached the following conclusions:

1. The names are too long to express things in frequent use.
2. The composition of these names present to the mind a combination of several ideas in order to designate individual objects, a defect that does not appear to be offset by the advantage of indicating the ratios between them.

The following extract from the history of the French Academy refers to the above conclusions:

"These reasons have led the academy to return to the second nomenclature, which it had at first rejected, and in making this selection of the new names it was noted that each one expresses but one simple idea, that they are very short, at least those designating the measures in frequent use; that they are very different from each other, preventing a confusion of one measure with another; the academy also observed that the names applied to the subdivi-

sions of the ordinary measures begin with different letters, so that in the abbreviations each division can be designated by a single letter."

But the leaders of the French Revolution would have nothing that reminded them of the past. Following the massacres of September, 1792, Louis XVI had been beheaded in January, 1793, the party of violence had gained control in June, and in the midst of the Reign of Terror, under the terrible Committee of Public Security, the decree establishing the metric system and adopting the Greek-Latin nomenclature was issued by the national convention on August 1, 1793. These metric names have been condemned by the experience of 130 years. Everywhere they are initialed, abbreviated, transformed, or abandoned in the futile attempt to adapt them to the needs of the people.

A comparison of the English and metric names reveals at once the superiority of the natural nomenclature and the inferiority of the artificial products of a combination between eighteenth century theory and the French Revolution:

English: Mile, furlong, rod, yard, foot, inch, line, acre, pound, ounce, dram, grain, bushel, peck, gallon, quart, pint, gill.

Metric: Myriameter, kilometer, hectometer, dekameter, meter, decimeter, centimeter, millimeter, kiloliter, hectoliter, dekaliter, liter, deciliter, centiliter, milliliter, hectare, are, centare, myriagram, kilogram, hectogram, dekagram, gram, decigram, centigram, milligram.

DIVISIONS AND MULTIPLES OF THE UNITS.

The ratios between the English units are necessarily irregular because convenient sizes can not be obtained by any uniform ratio whatsoever, whether decimal, binary, duodecimal, or what not. Furthermore, no uniform ratio is adapted for all uses. The binary divisions are the most easily understood and visualized, and facilitate many kinds of measurement; the duodecimal divisions offer certain important advantages by reason of the divisibility of 12 by 2, 3, 4, and 6; the decimal divisions are convenient for calculations because our system of numbers is based on 10, the binary and duodecimal fractions being to a very great extent easily convertible into decimals for that purpose, while it is frequently found convenient or necessary to divide the units by 3, 6, 7, 9, and other factors. For these reasons a perfect system of weights and measures must allow its units to be divided and multiplied in the way that may be found best adapted for the work to be done. This freedom is provided by the English system, as it is by all other systems of natural origin, for it is only by the process of natural selection that perfection in weights and measures is approached.

The users of weights and measures for thousands of years in all parts of the world have been left free to select the divisions and multiples of the units which proved to be best suited for their requirements. It is to be expected that weights and measures thus developed should in some respects fall short of complete perfection. When the English system is examined the occasion for wonder is, not that such shortcomings exist, but that they are so few in number and constitute such minor defects. Among these are the use of two tons, long and short, the use of troy and apothecaries weights, and the variation in liquid measures. These defects, however, are comparatively slight, and obviously the remedy for them is not to be found in an attempt to abolish the entire English system of weights and measures and substitute new standards. We have two tons. What we need is one ton less, not one more, the metric. We have two pounds. What we need is one pound less, not one more, the metric. We have three quarts, the dry, liquid, and imperial. What we need is two less, not one more, the metric liter. Multiple standards are reduced to unity by subtraction, not by addition. Moreover, the process of subtraction is already well advanced. The long ton, apothecaries and troy weights are obsolescent, while weight is displacing dry measure.

The process of displacing dry measures by weight is illustrated by the United States bushel of 2,150.42 cubic inches. In the United States the change is being accomplished by substituting "weight-bushels" expressed in pounds for measuring many farm products, approximations of the weight of a capacity bushel of the respective products, the use of which marks a stage in the transition from capacity measure to weight. The ease with which these weight-bushels can be reduced to a uniform pound basis was illustrated during the war when the food administrator brought about that reduction by ordering that "the licensee shall *quote, buy,* and sell potatoes only by the pound." And

yet the advocates of the metric system in the service of the Government have for years sought to discredit the English weights and measures by publishing and circulating long tables of weight-bushels legalized for farm and other products by the United States, the 48 States, the District of Columbia, and Hawaii, ignoring the high degree of uniformity they disclosed and the fact that weight-bushels mark a stage in the natural development of uniformity based on the pound. The unmistakable object of these tabulations has been to create a false impression of great irregularity in our English weights and measures.

This phase of the official propaganda to promote the use of the metric system was in evidence at this hearing when an official of the Bureau of Standards submitted Bureau Circular No. 10 containing a tabulation of weight-bushels, stating that "the document is an appalling confession for any nation to make." In this table 114 farm products, sand, 3 varieties of salt, 3 kinds of plastering hair, a total of 121 products, are tabulated and the legal bushel-weight of each given or the lack of a legal standard indicated for the United States, the 48 States, District of Columbia, and Hawaii, making a total of (51 by 121) 6,171 entries, the whole forming a bewildering mass of figures filling eight pages of a Bureau of Standards bulletin, with an explanation, belittling the uniformity that exists and ignoring the fact that these weight-bushels mark a close approach to complete uniformity on the pound basis.

It is indeed an appalling exhibition when Government officials, charged with the custody of our standards, use the resources of the Government in spreading this misrepresentation, distorting a stage in the natural substitution of the pound for the capacity bushel for the purpose of discrediting our fundamental weights and measures in the propaganda for compulsory metric legislation.

Not only are the irregularities in the English system of comparatively slight importance but their remedy is easily applied. Furthermore it should not be forgotten that the variation in our liquid measure has arisen, not from the operation of natural selection, but as a result of legislative interference with that process by the British Parliament in 1824.

The exclusively decimal divisions of the metric units have proved a failure. They have failed to give units of convenient size. They have failed to meet the wants of the people. They are not adhered to in any country. The metric units are divided and multiplied by successive halving and doubling in the futile attempt to escape from the decimal despotism.

The erroneous belief that its exclusively decimal divisions and multiples make the metric system superior to the English is due chiefly to a confusion of currency with weights and measures. The use of money consists mainly in counting it, adding, subtracting, dividing and multiplying, and it follows that for these operations the basis of the system of numbers, whatever it might be, will prove convenient for money. But even for money the decimal basis has its limitations, and when money is measured by coinage, rather than counted, the decimal basis is abandoned, the dollar being divided into halves and quarters. It is but a few years since the Director of the United States Mint recommended the coinage of a 2½-cent piece in order to supply a need of the people for divisions of the dime into quarters and of the dollar into eighths.

CORRELATION BETWEEN CUBIC CAPACITY AND WEIGHT.

Convenient correlations between cubic capacity and the weight of grain, wine, or water have been a feature of natural systems of weights and measures from the earliest of recorded times. A Babylonian cubic foot of water weighed a Babylonian talent of 80 Babylonian pounds. The Hebrew ephah was the weight of an Egyptian cubic ardob of water and equal to one-half of our avoirdupois ounce. A Roman cubic foot of water weighed 80 Roman pounds, hence called a quadrantal. The Roman congius, a capacity measure, was equal to 10 Roman pounds of wine. And to-day the English cubic foot of water weighs 1,000 ounces; the English cubic inch of water, 1,000 quarter-grains.

When the metric system was designed by the French scientists this correlation between cubic capacity and the weight of water was retained, the metric kilogram being the weight of a cubic decimeter of water, the gram the weight of a cubic centimeter of water.

Correlation between the metric units of cubic capacity and the weight of water has proved to be convenient in scientific work and in chemical laboratories. Equally convenient correlations between cubic capacity and the weight of water are found in the English system. So far as this feature is concerned, the English and metric systems are on an equality.

UNIFORMITY OF USAGE.

We have found that neither uniformity in the divisions and multiples of units, nor in their names, is desirable in a system of weights and measures; in fact, that in both of these features diversity is essential in order to adapt weights and measures to the needs of the people. On the other hand there are features of weights and measures in which uniformity is not only desirable, but constitutes one of their greatest merits. Among these are:

(*a*) Number of persons using a common system.
(*b*) Amount of work done by weights and measures.
(*c*) Area over which weights and measures are used.
(*d*) Time during which weights and measures have been in use.

Closely associated with the first three of these features are the possibility and probability of the development of uniformity in the future.

(*a*) *Number of persons using a common system.*—The ideal is for all the inhabitants of the earth to use the same weights and measures, and the extent to which a system of weights and measures has advanced toward that goal is rightly considered its greatest merit; the distance that separates it from the goal, its chief defect. Because of the local mixtures of weights and measures which compel the inhabitants of many countries to struggle with the confusion of two or more systems of measurement, any attempt to judge the comparative merits of the English and metric systems by classifying the earth's inhabitants according to the systems of weights and measures used, is necessarily misleading. Careful study of the conditions in each country is necessary in order to avoid erroneous conclusions.

In making such a study of world conditions the outstanding fact is that the section of the human race that possesses a common system of weights and measures which is fundamental, coinciding in respect to both time and place with the settlement of the country and the growth of the population, is what we call the English-speaking world, comprising the United Kingdom, the United States, and certain British dominions, with an aggregate population of 179,457,000. Embodying the essential features of the natural system that has been developed through the ages, dating in England back to the Roman conquest, and in other countries to the first English settlements, the English system of weights and measures in the English-speaking world stands preeminent in respect to its fundamental character and its uniformity of use by 180,000,000 people.

Compared with the English system, the metric system is a newcomer, having been forced into use in France 130 years ago. Wherever introduced the metric system has become mixed with weights and measures already firmly established, so that the so-called metric countries, including even Continental Europe, where it originated, present to-day a confusion of weights and measures due to the mixture of the metric units, which the law has forced into use, with the old local and the English measures which the people can not or will not abandon. One hundred and thirty years of compulsory metric law in these countries has resulted in changing the people's standards to the metric basis where the change was easy, as in the market place and the government service, and leaving them partially or wholly unchanged where the change was difficult, as in the various branches of textile manufacturing, the general result being serious confusion, with the use of the metric system predominating in countries having an aggregate population of 358,331,000.

In order to make a fair comparison between this population of 358,331,000 using a mixture of metric, local, and English weights and measures, with the metric predominating, it is necessary to add to the 180,000,000 inhabitants of the English speaking world, with its unique uniformity on a fundamental English basis, the population of various countries in which the English system predominates, although still used along with local and, to a slight extent, metric units. Russia, with a population of 164,100,000, possesses a uniformity of linear measures on an English basis, Peter the Great having introduced the English linear measures into Russia by bringing home with him from England in 1698 a number of ship carpenters and other workmen to teach their trades to his people. The Russian duim is the English inch; the Russian foot is the English foot; the Russian archine is 28 English inches; the Russian sagene is 7 English feet; the Russian verst is 3,500 English feet. Russian weights, however, are still Russian, but the identity of Russian linear measures with the English frequently and not unnaturally leads to including Russia with the English speaking world in respect to the use of English weights and measures.

In addition to Russia, there are India, Egypt, Cuba, and Panama in which different systems of weights and measures are used, with the English system in predominant use by a populataion of 495,400,000. This with the population of Russia added to the 179,457,000 of the English speaking world, gives a total population of 674,857,000, which taken as a whole can be compared with the 358,331,000 inhabiting the metric countries. In the remaining countries of the world there is a population of 667,495,000 using either local weights and measures of considerable diversity, as in China, Japan, and Turkey in Asia, or practically no weights and measures at all, as in certain backward countries, these forming a group that is not comparable with either the English or the metric countries in respect to the weights and measures used.

(*b*) *The amount of work done.*—Any attempt to determine the amount of work done by the English and metric systems must necessarily fall short of accuracy, a rough approximation being the best that can be accomplished in making such a comparison. Probably the national wealth and income of the respective groups afford the best attainable basis on which to judge of their comparative productive power. These values have been estimated since the war by recognized authorities for the principal countries of the world, and taking their figures for continental Europe, where the meter predominates, and for the United Kingdom, Australasia, Canada, and the United States, where the inch is the fundamental standard, the comparison of the wealth and income of the two groups is as follows:

	Inch group.	Meter group.
Wealth	$490,000,000,000	$310,000,000,000
Income	70,000,000,000	24,000,000,000

(*c*) *Area over which weights and measures are used.*—Excluding the polar regions, Central Africa and the Sahara Desert, there remains 38,677,346 square miles of inhabitable area of the earth's surface that, like its population of 1,547,768,000, can be classified by three divisions, according to the prevailing weights and measures. First comes the English-speaking world, unique and incomparable, with its uniform and fundamental system of standards and language, with a population of 179,457,000, spread over an area of 10,673,862 square miles. Next comes Russia, possessing a uniformity of linear measurements based on the English units, with a population of 164,100,000, inhabiting an area of 8,300,000 square miles. Then comes the group Cuba, Panama, India, and Egypt, with the English system predominant, a population of 331,300,000, and an area of 2,241,878 square miles. These countries form the first division, with a population of 674,857,000, and an area of 21,215,740 square miles.

The second division in which the metric system predominates, with great confusion caused by the concurrent use of local and English measures, has a population of 358,331,000 and an area of 7,531,099 square miles.

The third division comprises the remainder of the total area, in which local measures prevail, making no pretensions to world domination. Here is found a population of 514,580,000 and an area of 8,898,631 square miles. These classifications of population and area can be visualized by this table:

	Square miles.	Population.
English fundamental or predominant	21,215,740	674,857,000
Metric predominant	7,531,099	358,331,000
Local predominant	9,930,507	514,580,000
	38,677,346	1,547,768,000

With the comparative uniformity of usage before us, who can doubt the predominance of English weights and measures at the present time? And when we contemplate the changed control of the earth brought about by the war, the vast possibilities of increase of population in the English area, the already crowded metric and local areas, who can doubt that the English is the world's predominating system, not only of the present, but of the future?

(*d*) *Time during which weights and measures have been used.*—A feature that adds materially to the value of a system of weights and measures is the time during which it has been in use by the inhabitants of a country. A change from one standard to another makes it impossible to compare weight and measure records after the break with those before it without a reduction of values that for most purposes is too laborious to be practicable whether in public or private affairs. In English-speaking countries the continuity of use is perfect, the same standards having been in use from the beginning of history. We accept this uniformity as a matter of course, because there has been no break in our fundamental standards, and, happily, shall continue to do so unless a new system of measures is forced on us. Then we would find, when too late to retrace the false step, the great value that continuity of use imparts to common standards of weights and measures.

Designed and forced into use in 1793, the metric system has but 129 years to its credit, and nowhere has it attained the fundamental and exclusive character possessed by the weights and measures of the English-speaking world. Not only did its introduction break the continuity of weights and measures on the Continent of Europe, necessitating conversions from one standard to the other in order to compare the records preceding 1793 with those that followed, but the persistence of the old measures after the metric system was established has involved the people of metric Europe in the confusion and time-wasting conversions of multiple standards ever since, with no prospect of an end to the confusion even after 130 years.

CONCLUSIONS FROM THE COMPARISON.

We have compared the English and metric systems in respect to the five essential features of weights and measures, (1) sizes of the units, (2) names of the units, (3) divisions and multiples of the units, (4) correlation between cubic capacity and weight of water, and (5) uniformity of usage. We find that the English system is far superior to the metric system in respect to four of these features and is on an equality with the metric system in respect to the other--correlation between cubic capacity and weight.

The truth that the English system is far superior to the metric has long been lying at the bottom of the well, while the delusion that the metric system is perfect and the English system is a jumble and the hodgepodge product of chance has been spread throughout the world. This concealment of the truth and the spread of error are due to a combination of causes:

1. The English system of weights and measures is so deeply rooted in the lives of the people that, like the English language, we lose sight of its priceless value and intrinsic merits, and are oblivious to the dangers that threaten it.

2. The metric system having been designed by scientists for scientific work, has become the system of the laboratory, the classroom, and the textbooks; scientists and educators, with notable but comparatively few exceptions, falling into the natural error of concluding that the weights and measures with which they have become familiar in their restricted field must necessarily be the best for all people.

2. The educators and scientists possessing exceptional advantages for molding the opinions of others, have instilled prometric errors into the minds of both young and old, and thus maintained a powerful prometric propaganda as part of their daily work.

4. This educational and scientific propaganda has been reinforced by a group of officials in Government bureaus, who, to the influence of educators and scientists, have added the prestige, power, and facilities of the Government itself, presenting the anomalous spectacle of the people's resources being used to destroy one of the most valuable of the people's possessions.

These are the chief influences that account for so many people believing that the better system of weights and measures is the inferior one; that the inferior system is perfect. It is because of these common errors, which have been in evidence during the hearings on S. 2267, that I have here made a comparison of the English and metric systems.

THE DUTY OF CONGRESS.

Summing up the truth about the English and metric systems, we find that the introduction of the metric system by education is a failure; that its introduction by making it the standard for Government business is a failure;

that laws forcing the people to use it are out of the question; that any partial success in introducing the metric system by any of these three methods is certain to cause the incurable confusion of double standards, for once introduced it will be impossible to get rid of the metric system, as it is now impossible to abolish the English; that as a matter of fact the English system we now have is far superior to the metric system it is proposed to introduce; and that consequently it is a duty that we owe to posterity to protect our established English system so far as possible against any and all mixture with the metric or any other alien system.

It is on Congress that the responsibility rests of saving the United States from the calamity of a mixture of the metric system with the English system, for it is to Congress that the Constitution gives the exclusive power to fix the standard of weights and measures. Up to the present time Congress has wisely allowed the English system to remain the fundamental standard of the United States. The legislators, appalled by the difficulties involved in the undertaking, have rejected all proposals for radical changes in our established weights and measures.

Brought here by the first English colonists over 300 years ago, the history of the English system of measurement in America consists of five fairly well-defined periods.

THE FIRST OR COLONIAL PERIOD.

First came the colonial period, when English weights and measures, with the English language and English law, were slowly becoming rooted in the life of the people, making this part of the New World a real New England. Acknowledging allegiance to England, the inhabitants of the American colonies established these institutions as firmly here as they had been established in the mother country. Warring with nature and the redskins in their struggle for existence, with no scientific propaganda to promote an artificial system, the successive generations of the colonial period retained the weights and measures that were so perfectly adapted to their needs, allowed their development by natural selection to continue free from interference by the clumsy hand of compulsory law, and thus the English system became the American system of measurement and weight.

THE SECOND PHASE OF DEVELOPMENT.

The second phase of the development of our weights and measures began with the end of the Revolutionary War and the establishment of the United States Government, 1783–1789, events that coincide closely with the invention and introduction of the metric system in France in 1790–1793. For the next 30 years Congress, occupied with the organization of the Government, naturally turned its attention to the regulation of weights and measures. At the request of Congress, Secretary of State Thomas Jefferson in 1789 submitted two plans for reorganizing the English system, without recommending either, this before he had learned of the metric system proposed in France. The representatives of France sought to interest our Government in the adoption of the French metric system, while the importance of regulating weights and measures was repeatedly urged on Congress in presidential messages.

Finally in 1817 the Senate, in order to settle this important question right, asked John Quincy Adams, then Secretary of State, to investigate and report upon it. His investigation, begun with an admiration for the theoretical merits of the metric system, lasted for four years, his report, presented to Congress on February 22, 1821, marking the beginning of the third era in the weights and measures of the United States.

Congress, after considering this report, was overwhelmed by the difficulties of the undertaking and, recognizing the impossibility of changing the fixed habits of the people in measuring and weighing, adopted Adams's recommendation that no innovation upon existing weights and measures be attempted. Adams's advice has remained the settled policy of Congress now for more than 100 years, but during this time the agitation for innovation has assumed phases that warrant the division of the century into three periods, the third, fourth, and fifth in the development of our weights and measures.

THE THIRD PERIOD.

The third period, beginning with 1821, was marked by an almost complete absence of agitation for a change in our weights and measures, the situation

being a return to the conditions during the first or colonial period. There had been no popular demand for a change, and Adams's masterly report had revealed so clearly to Congress the vast extent and intricacies of the problem that the legislators, bewildered by the difficulties involved, were quite willing to leave the fundamental English system untouched by legislative tinkering. In their control of weights and measures the United States and British Governments during this period conformed to the fact that the fundamental standards were identical in both countries. The material standards of the Untied States were taken to London from time to time and there compared with the material standards of the British Empire in order to keep uniform the weights and measures of these two sections of the English-speaking world.

During this period two noteworthly events occurred, one carrying a warning against change by one section that is not made at the same time by all sections of the English-speaking world; the other illustrating the great truth that the fundamental English standards are not the metallic bars and blocks in the custody of Governments, but are the lengths and weights actually used by the people in their daily work. In 1924 the British Government abolished the use of the old English liquid measure based on the wine gallon, then common to both the British Empire and the United States, and established a new measure for liquids based on an imperial gallon of 10 pounds of water.

This affected the standard, that for measuring liquids, which could be most easily changed. As a result of that independent action by Britain the divergence in the liquid measures of the English-speaking world to-day, after the lapse of nearly a century, marks the only important break in the uniformity of this great section of the human race. Fortunately this irregularity exists where it causes the least inconvenience—in liquid measurs—and, furthermore, the relation between the old English wine measure in the United States and the imperial measure of Britain is such as to facilitate conversion from one to the other, 100 pounds of water being equal to 12 United States gallons and to 10 imperial gallons. The British mistake of 1924 and its consequences will not be without their compensation if they prevent independent action by any section of the English-speaking world in the regulation of our English weights and measures.

The other event to which reference has been made was the destruction of all the prototype standards of the British Empire in the fire that destroyed the Parliament House at London in October, 1834. The reproduction of these standards from the pendulum beating seconds at Greenwich in accordance with the legal definition was found to be impossible, and they were finally derived from the best material standards to be found in the United Kingdom, the British dominions, and the United States. Our Government ordered a set of United States standards made and presented them to the British Government. And when the new British standards were completed a duplicate set was presented by the British Government to the United States. Further on I will call your attention to the fate of these British standards and of the case in which they were delivered to our Government.

The destruction and restoration of the British standards demonstrates in a way never to be forgotten the fact that the fundamental standards of the English-speaking world are in the final custody, not of government officials, but of the people themselves.

THE FOURTH PERIOD.

In the late fifties of the last century a movement began for decimalizing our weights and measures, which was soon merged into an agitation for the compulsory introduction of the metric system, its principal support coming from a few educators and scientists who, attracted by the decimal theory and with no other experience with metric weights and measures than their restricted use in the laboratory and classroom had afforded, believed that it was necessary only to pass a metric law and teach the metric system in the schools in order to abolish the English standards in a very short time and put the metric standards in their place. The sentiment thus created met with no active opposition and resulted in the introduction of a bill in Congress in 1866 making the use of the metric system compulsory. Congress refused to pass a compulsory metric bill, but the agitators succeeded in getting passed by both House and Senate the act of July 28, 1866, making the use of the metric system permissive, this being accomplished in Congress without any discussion worthy of the name.

The enactment of the law of 1866 marks the beginning of the fourth or what may be fittingly called the pedagogic period in the history of our weights and measures, which began with high hopes and great enthusiasm on the part of the metric devotees in the early success of their plan to change the weights and measures of the United States. Experience soon proved that they were mistaken; that the weights and measures of the American people could never be changed from the English basis to the metric by teaching the metric system to school children and extolling its theoretical merits in the press and lecture room.

The enthusiasm that ushered in the fourth period in 1866 steadily waned, and 10 years later, in 1876, it began to assume the form of a thinly disguised movement to make the use of the metric system compulsory. Several attempts to secure compulsory metric legislation having failed during the 24 years following 1876, the metric movement in 1900 assumed a new form under which the prestige of the educators was reinforced by what was in fact an organization of metric enthusiasts in official positions who were able to use the resources and authority of the Government to promote the metric propaganda.

THE FIFTH PERIOD.

This development was brought about by the organization of the Bureau of Standards in 1901, an event that marks the beginning of the fifth period in the history of our weights and measures, the period of organized bureaucratic agitation. The metric movement at once received a new impulse from a combination of powerful forces. To the influence of educators there were now added the prestige and authority of men of scientific training occupying official positions. The metric propaganda behind which the combined forces were massed in 1901 threatened the substitution of incurable confusion of weights and measures for established uniformity. The danger arising from this movement was increased by the willingness on the part of the legislators to transfer to Government bureaus the regulation of weights and measures for which the Constitution had given the exclusive authority to Congress. The readiness with which Congress relinquished this constitutional duty was equaled by the alacrity with which the bureau officials assumed the task. Only brief references to a few of the moves in the bureaucratic propaganda for the metric system that began in 1901 can be made here, but they will make plain the perils to which our established weights and measures have been constantly exposed during this period.

Seven weeks after it was brought into existence by law on March 3, 1901, the Bureau of Standards established close connections with the metric propaganda when the newly appointed director at a meeting of the American Metrological Society announced that the influence of the bureau would be exerted in favor of the metric system.

Here are a few of the events that show how well that promise has been kept for 20 years: The appointment of the director as a member of the American Metrological Society's committee on legislation to confer with the House Coinage Committee; the nearly constant attendance of the director at the hearings on metric bills from 1901 to 1906; his drumming up prometric witnesses for these hearings; his cross-examination of antimetric witnesses; his prompting of supporters of metric bills; his close watch on the progress of these bills, enabling him in 1902, three weeks in advance of the committee report, to inform the Secretary of State that the metric bill would be favorably reported by the Committee on Coinage, Weights, and Measures; discrediting the English system and lauding the metric system in addresses by Bureau of Standards officials before trade associations, by lectures and articles contributed to annuals, encyclopedias, and other publications; the bureau's distribution of prometric literature; the director of the bureau becoming a member of the executive committee of the American Metric Association, whose object is to promote compulsory metric legislation; the bureau officials organizing in 1905 an annual conference of weights and measures officials, Federal and State, at Washington for the announced purpose of facilitating National and State legislation pertaining to weights and measures, and which has since continued without constitution and by-laws; the boast in the conference that "this body of delegates is strong enough to secure what is needed"; bureau officials rounding-up delegates to the annual conference; sending out in one year over 4,500 letters appealing for attendance at the conference; the bureau officials expressed a desire that every one at the conference be an agent of

the Bureau of Standards; framing weights and measures laws, Federal and State, at the annual conference under the control of the bureau's bureau officials giving the delegates to the conferences instruction in promoting legislation; the bureau official's refusal to aid a trade organization in framing the berry-basket standardization bill unless it provided specifically for the use of the metric system; charging a smaller fee for official testing metric measures at the bureau than is charged for testing English measures; the bureau official's proposal to get its centralizing legislation affecting weights and measures attached to an appropriation bill; the Bureau official's [illegible] metric propagandist to place the entire resources of the Government behind the metric movement; framing under bureau auspices, introduction in Congress, and indorsement by the conference of a bill giving the [illegible] bureau control over all weighing and measuring devices, making the metric system the standard of the United States and relegating the [illegible] to a subordinate position; the alliance of the bureau officials with [illegible] tion promoting legislation to substitute the Centigrade [illegible] Fahrenheit; the appointment of a bureau official as chairman of [illegible] organiaztion's Centigrade committee, using the bureau [illegible] which mail intended for the committee was addressed [illegible] circular letter appealing to academies, societies, faculties, [illegible] sions of opinion as a guide to members of Congress on the [illegible] bureau official bringing the Centigrade bill before the conference [illegible] dorses it; the bureau official's standing offer to send [illegible] legislatures to discuss weights and measures [illegible] ing with local officials to secure State legislation [illegible] conference with funds that could [illegible] official's declaration that there is not a [illegible] vinced that he should be active in pushing legislation [illegible] officials declaration in the conference [illegible] nothing or next to nothing about weights and measures [illegible] educating them; the bureau official's [illegible] given to weights and measures [illegible] their attention, and to [illegible] hurried adoption of a [illegible] by the bureau official [illegible] his State organization [illegible] enacted; the bureau official's [illegible] blank forms mailed [illegible] large type, that of Congress [illegible] of outside propaganda [illegible] enter the bureau and [illegible]

The above [illegible] propaganda which [illegible] for nearly [illegible] years [illegible] by Congress and [illegible] that bureau [illegible] protect our fundamental [illegible] all their efforts [illegible] and to secure the [illegible] orders.

There is one [illegible] direct your [illegible] has animated the [illegible] by law and [illegible] constitution [illegible] in connection with [illegible] have been [illegible] more the [illegible]

No [illegible] began a [illegible] measures which [illegible] its first settlement [illegible] metric system [illegible] up this [illegible] Measures [illegible] France [illegible] Standards [illegible]

secretary of the Bureau of Standards sent to the British consul in New York a statement on the status of the metric system in the United States, which was subsequently approved by the director, in which this passage appears: "From the above you will see that this country has taken a long step toward the adoption of the metric system, and so far as our fundamental standards are concerned we are to-day upon a metric basis."

First, I will point out to you the falsity of this statement. The law of 1866 legalizing the use of the metric system defined the meter as 39.37 inches, the English standard, the same in the United States and throughout the British Empire, being thus expressly recognized by Congress as fundamental, the meter being 3937/3600 of a yard. The exact equivalent of the meter was 39.370113 inches, so that the law of 1866 in fact established a legal meter in the United States differing from the standard meter of the metric system.

In order to circumvent this plain effect of the law of 1866, the officials of the Bureau of Standards have put forward the claim that the law of 1866 made the yard 3600/3937 of a meter. This is true if by "a meter" is meant the meter established by Congress in 1866 as 3937/3600 of a yard. But the officials of the Bureau of Standards have ignored this necessary stipulation when inverting the fraction and have spread broadcast throughout the world the false impression that the United States yard is 3600/3937 of the meter standard of the metric system at Sevres, France, and that consequently the inch in the United States differs from the inch in England. As a result of this claim, published with the full authority of the United States Bureau of Standards, the erroneous belief prevails quite generally among people having to do with standards of high precision in all parts of the world that the inch of the United States and the inch of England are different, whereas the truth is that they are the same and can not be made to differ except by an act of Congress or of the British Parliament.

The manner in which the officials of the Bureau of Standards have treated the material standards intrusted to their care has been in keeping with the misrepresentation regarding the legal standards of the English and metric systems. From the time of the first English settlement in this country it had been the custom to verify the United States standards of weights and measures by taking them to London for comparison with the standards of England, the last of these comparisons having been made in 1888. Since the development of the misrepresentation regarding the standards of the United States, this practice of comparing standards at London has been abandoned. The metric bars and weights received from France have been guarded carefully in the vault of the Bureau of Standards and regularly taken to France for comparison with the metric standards at Sevres; while the English standards which had been presented to the United States Government by the British Government, have been treated as antiques or junk, worthless as standards. These English standards became the playthings of the officials of the Bureau of Standards, who are known to have sent them to the St. Louis Exhibition where they were exhibited as antiques, the discarded standards of a system that was certain to be abandoned by the United States.

When delivered to the United States Government by Great Britain in 1856, the standards had rested in a case of rare wood and unusually fine workmanship. The officials of the Bureau of Standards treated this case, the property of the United States Government as roughly as they treated the English standards themselves. On May 25, 1920, evidence of its fate was supplied at a session of the conference on weights and measures, when a State official, vice president of the conference, presented to the Director of the Bureau of Standards, the president of the conference, a gavel made of a fragment of the case in which the standards had been received from the British Government in 1856. Broken up to make a gavel with which the Director of the Bureau of Standards presides over a gathering of officials having neither constitution nor by-laws, calld for the purpose of increasing the power of the bureau and securing legislation that will make the use of the metric system compulsory and that of the English system illegal in the United States.

These events demonstrate beyond question the fate that is in store for the weights and measures of the United States, future confusion in place of existing uniformity, unless Congress exercises its exclusive authority under the Constitution and takes effective measures to keep administrative officials where they belong.

The officials of the Bureau of Standards, armed with the dominating prestige *derived from official* station, dealing with scientific and technical questions

which very few need to understand, housed in imposing buildings with what is probably the most elaborate and expensive equipment of scientific apparatus of its kind in the world, possessing wide discretion in the free use of the Government's facilities for printing, mailing, and office work, located within a few minutes of the Capitol and executive departments of the Government and thus able to keep in close touch with legislative and administrative developments, able to travel at the Government's expense to all parts of the country, frequently visiting foreign countries on the same expense basis, leagued with State, county, city, and town officials who bow to the superior power of the Federal officials, free from the danger of a searching investigation by anyone competent to judge of the efficiency and value of their work, receiving the approval of their successive superiors, who, engrossed in other and unrelated matters, have fallen into the habit of accepting the Bureau of Standards as the one perfect institution in the machinery of government, secure in their positions so long as they possess the good will of the bureau's director, led for 21 years by an official possessing extraordinary skill in organization of this kind, in upholding the prestige of the bureau, in concealing a poor opinion of legislative competency to pass on matters affecting weights and measures, and in securing from the legislators huge appropriations and unquestioned approval of the bureau's work, their path cleared by the legislative indifference and disinclination to go into the scientific and technical details of the bureau's activities, the officials of the Bureau of Standards, animated by the undeviating purpose of their leader to establish the metric system and abolish the use of English weights and measures in the United States, have for 21 years been the powerful nucleus from which have radiated to all parts of the United States and its outlying possessions the forces back of the agitation for compulsory metric legislation. Their propaganda for compulsory metric legislation marks the period of bureaucratic propaganda, the fifth and still unfinished stage in the development of the weights and measures of the United States.

HOW OUR WEIGHTS AND MEASURES SHOULD BE REGULATED.

What is the duty of Congress in the regulation of the weights and measures of the United States? It is plain that in the discharge of this duty Congress should be governed by three general principles:

First. To restrict the use of non-English weights and measures, whether of the metric or other system, keeping United States standards so far as possible on an exclusively English basis.

Second. To take no important step affecting the English units of weights and measures, or their use, without consultation and agreement with all sections of the English-speaking world.

Third. To shape legislation affecting weights and measures so as to harmonize Government control and the natural process of evolution by which the English system has been developed, the two influences working together, bringing the English weights and measures nearer the ideal of perfect adaptability to the work of the world and the greatest attainable uniformity of usage.

In carrying out these general principles in the regulation of weights and measures, there are certain definite measures the necessity for which will be obvious from what has already been stated.

(*a*) First. The misuse of the authority and resources of the Government for carrying on metric propaganda should be stopped at once, and the officials of the executive departments should be made to understand that their duty consists in obeying and administering the law, and not in evading it or carrying on propaganda for changing it.

(*a*) Close attention and careful scrutiny of every measure affecting weights and measures should take the place of the indifference and neglect that have become habitual.

(*c*) The Government should print at once John Quincy Adams's report on the metric system, adding to it a carefully prepared index to facilitate reference to this extraordinary document. For thorough comprehension of the subject of weights and measures, for breadth of vision and farsighted statesmanship, the equal of Adams's report is not to be found in any language. For years it has been out of print, and anyone desiring a copy has been compelled to search in second-hand book stalls. It should be made a reference book for legislators and all interested in the subject of weights and measures. It consists of about 70,000 words. The report of the testimony at the present hearings on the Ladd bill up to the close of the case for the proponents comprises about 128,000

words. I urge that your committee recommend that Adams's report be reprinted at once. Congress should give no consideration to any law affecting our weights and measures until this is done.

(*d*) The former practice of comparing the material standards of the United States with the standards of Great Britain should be resumed, in order that the accuracy and permanency of the weights and measures of the English-speaking world may be assured by direct comparison of the standards of every section with the prototype standards at London.

(*e*) At the earliest practicable date representatives of the Governments of Great Britain, the British Dominions, and the United States should meet for the purpose of conferring on measures to be taken for the protection and uniform development of their common weights and measures.

The adoption of these measures is the plain duty of Congress in view of the threatened confusion of weights and measures that is sure to result from a continuation of the bureaucratic propaganda or any success in securing legislation compelling the use of the inferior metric system in the United States.

SAMUEL S. DALE.

STATEMENT OF MR. FREDERIC Q. BOYER, REPRESENTING NATIONAL INDUSTRIAL CONFERENCE BOARD.

The CHAIRMAN. Mr. Boyer, kindly state your name and for whom you appear.

Mr. BOYER. Frederic Q. Boyer, representing the National Industrial Conference Board, with a local office at 703 Southern Building, Washington, D. C.

The CHAIRMAN. You are the accredited agent of this board?

Mr. BOYER. Yes, sir.

The CHAIRMAN. As I understand it, you have a brief which you desire to submit on behalf of your organization?

Mr. BOYER. Yes, sir.

The CHAIRMAN. Which occupies a neutral position in this controversy?

Mr. BOYER. Yes, sir.

The CHAIRMAN. Does it discuss the bill at all?

Mr. BOYER. It discusses a few points in the bill.

The CHAIRMAN. It is mainly historical in character?

Mr. BOYER. Yes; with facts and arguments for and against which have been put in logical form, so that they can be very easily interpreted. It was gotten up primarily in anticipation of this bill.

The CHAIRMAN. Do you desire to make an oral statement in addition to the brief you are submitting?

Mr. BOYER. Not unless you have some questions.

The CHAIRMAN. I will read the brief when I have opportunity, and before the hearings are concluded I may want to ask you some questions. You are located here in Washington?

Mr. BOYER. Yes, sir.

(The brief referred to is here printed in full, as follows:)

NATIONAL INDUSTRIAL CONFERENCE BOARD,
10 East Thirty-ninth Street, New York, November 14, 1921.

Hon. CHARLES L. MCNARY,
Chairman Subcommittee of Senate Committee on Manufactures,
Washington, D. C.

MY DEAR SENATOR: The National Industrial Conference Board, a cooperative body of appointees from 32 National and State associations of industrial producers, representing practically all branches of American industry, begs leave to submit for your consideration and convenience a statement containing excerpts and diagrams from its recently completed Research Report No. 42, entitled "The metric versus the English system of weights and measures." The conference board also takes pleasure in sending under separate cover to you and to Senators Andrieus A. Jones and Ovington E. Weller, your associates on the subcommittee, cloth-bound copies of the above-mentioned Research Report No. 42.

This research report represents the result of careful scientific inquiry by the conference board's staff under the guidance of an advisory committee of prominent industrialists of broad business experience and scientific attainment, some of whom favor and others oppose the compulsory adoption of the metric system of weights and measures in the United States. The full approval of the research report by all members of the advisory committee and by the members of the National Industrial Conference Board indicates that the report presents accurate

and comprehensive information on the subject at issue, and an impartial synopsis of arguments, both for and against the proposal that the metric system be substituted for the existing system of weights and measures in the United States.

In its desire to aid the subcommittee of the Senate Committee on Manufactures and the Congress of the United States in considering the merits of Senate bill 2267, "To fix the metric system of weights and measures as the single standard of weights and measures for certain uses," and other congressional bills of similar character, the National Industrial Conference Board at its regular meeting on October 20, 1921, passed the following resolution:

"*Resolved*, That a representative of the board's staff should present to the subcommittee of the Senate Committee on Manufactures hearing arguments for and against Senate bill 2267, a written statement outlining the principal advantages and disadvantages of the compulsory adoption of the metric system of weights and measures, as contained in the Board's Research Report No. 42, entitled "The metric versus the English system of weights and measures"; also to reply to questions of the committee by reference to the facts contained in the board's research report; but in line with the policy of the board, not otherwise to express on his own behalf, or on that of the board, any opinion either for or against the pending bill; and further

"*Resolved*, That a copy of this resolution be submitted to the Senate committee with the above-mentioned statement as indicating the neutral position of the board is scientifically investigating the issues involved in the proposed adoption of the metric system."

Naturally, in considering the legislation proposed, certain questions of paramount interest immediately arise and press for answer. These relate to:

(*a*) Intrinsic merits of the metric and English systems.

(*b*) Present use of the metric and English systems generally and in special fields.

(*c*) Effect on American industry generally and on fundamental mechanical standards of substitution of metric for English system.

(*d*) Effect of such substitution on the general public.

(*e*) Cost of such substitution.

(*f*) Probable length of transition period as experienced in similar change in other countries.

These and other matters of importance, such as—

(*g*) Need for compulsory legislation to effect such a change.

(*h*) Nature and extent of the demand for a change.

(*i*) Comparison of metric and English systems for universal use are dealt with in the statement that is hereto attached.

The principal facts and arguments here quoted by way of excerpts from the Conference Board's Research Report No. 42, are further substantiated by detailed descriptions and evidence contained in the report itself.

Respectfully submitted.

NATIONAL INDUSTRIAL CONFERENCE BOARD,
By M. W. ALEXANDER, *Managing Director*.

STATEMENT IN RESPECT TO THE METRIC SYSTEM VERSUS THE ENGLISH SYSTEM OF WEIGHTS AND MEASURES.

[Excerpts from research report No. 42 of the National Industrial Conference Board.]

A. INTRINSIC MERITS OF THE METRIC AND ENGLISH SYSTEMS.[1]

Metric contentions.—Metric proponents picture the ideal system of weights and measures as one that is constructed to have the smallest possible number of units, simple ratios between the units, and a simple correlation between the units of length, capacity, and weight; i. e., the simpler the structure, they contend, the more readily will the system be comprehended. The metric system, they insist, with its decimal and scientific correlations. meets these ideal requirements. It is simple in structure and its units are easily convertible, being scientifically related and divided into tenths and multiples of 10; the units are few and their names are easily learned, for which reasons, they say, the whole system is more readily comprehended by the average person than is the English system.[2]

As for convenience, metric proponents contend that those elements of their system which make for simplicity likewise make for convenience, viz, uniform

[1] For detailed metric contentions and English answers see pp. 123–140 of report.
[2] P. 136.

decimal and scientific relationships between the units. They assert, also, that their system has proved to be readily adapted to mechanical and other needs and comprehensive in filling the requirements made of it.[3]

English answers.—English proponents maintain that the English system is intrinsically superior to the metric, because its fundamental units, such as the inch. foot, pound, ton, quart, gallon, have developed from the eternal process of a natural selection of fittest units and not as the result of a rigid inflexible plan; because it multiplies and divides its units not only decimally to meet certain limited needs, but also binarily and duodecimally to meet other and much more extensive needs; because the character and names of its units are so tied in with everyday experience that they are readily learned and retained; and because the features just mentioned make the English system, as compared with the rigid and inflexible metric system, much more comprehendible to the average mind, and more convenient, adaptable, and comprehensive in filling the needs a system of weights and measures is called upon to fill.[4]

In this connection English proponents point to such facts as those illustrated in Diagram I, namely, that the natural local units in countries the world over are closely related to the units of the English system.

B. PRESENT USE OF THE METRIC AND ENGLISH SYSTEMS GENERALLY AND IN SPECIAL FIELDS.

Diagram II [5] indicates the distribution of world population on the basis of the predominant use by countries of the metric and English systems. The metric system is in predominant use in 37 countries,[6] with a population of 395,521,000; the English system is in predominant use in 12 countries,[7] with a population of 343,557,000; and 28 countries,[8] with a population of 823,700,000, do not use either the metric or the English system predominately.

Diagram III, indicating the distribution of world export trade in 1919 according to groups of countries using the English and metric systems, should be viewed in connection with the following excerpt:

Summing up the whole discussion of the world-wide aspects of the English and metric systems in foreign trade, it appears that general export and import figures, trade relations between English, metric, and other countries, and the nature of the products exported from English countries, all confirm the observation already made that the English system of weights and measures is being projected into metric and other countries to a very considerable extent through the export trade of the United States and Great Britain, and that the reciprocal influence of the metric system is much smaller.[9]

Diagram IV, indicating the distribution of exports of the United States according to groups of countries using the metric and English systems, should be considered in relation to the following excerpt:

* * * The interests of foreign trade are naturally along the line of establishing a uniform system of weights and measures the world over. So long as substantial uniformity is secured, however, there is no reason why this field should prefer any one system over another except as one or the other system is found to be already in predominant or increasing use. The facts indicate that the trade of the world is not carried on more in the metric system than it is in the English, and that, as a matter of fact, the English system predominates. Furthermore, in considering a compulsory change to the metric system in the United States, the loss of the Nation's vast trade with English and other countries must be weighed over against any gain in trade that might be secured with metric countries.[10]

---

[3] P. 137.
[4] P. 140.
[5] See also, pp. 15–18 of the report referring to this diagram.
[6] Argentina, Austria, Belgium, Brazil, Bulgaria, Chile, Congo, Colombia, Czechoslovakia, Denmark, Finland, France, Germany, Haiti, Hungary, Italy, Jugo-Slavia, Latvia, Liechtenstein, Luxemburg, Mexico, Monaco, Montenegro, Netherlands, Nicaragua, Norway, Paraguay, Philippines, Poland, Portugal, Rumania, Spain, Eweden, Switzerland, Tunis, Uruguay, and Venezuela.
[7] Russia (measures in length), United States, Great Britain, Canada, New Zealand, South Africa, British Guiana, Australia, Liberia, Straits Settlements, Porto Rico, and Santo Domingo.
[8] Abyssinia, Afghanistan, Armenia, Bolivia, China, Costa Rica, Cuba, Ecuador, Egypt, Greece, Guatemala, Hedjaz, Honduras, India, Japan, Mesopotamia, Morocco, Nepal, Oman, Palestine, Panama, Persia, Peru, Salvador, Siam, Syria, Tripoli, and Turkey.
[9] P. 110.
[10] P. 112.

As bearing upon special fields of activity in the United States, the following excerpt gives important information in respect to the question it issues:

Diagram V illustrates graphically the outstanding features of the situation regarding the use of weights and measures in various fields in the United States as described in the preceding pages. The area of the outer circle, including that of the inner, represents the 71,500,000 people in the United States in 1910, 10 years of age and over, most of whom are affected by the use of weights and measures as the buying and traveling public. The portion of this 71,500,000 included in the area of the inner circle, i. e., 38,000,000, represents the total of productive workers 10 years and over in 1910. This inner area is divided into sectors indicating how the working population was distributed in various specialized fields. The two shaded sectors, i. e., science and engineering and foreign and wholesale trade, represent, as has been pointed out, the only fields interested to any extent in seeing the metric system adopted in the United States. A comparison of these small sectors with others, and also with the complete area of the outer circle, gives a rough idea of the relative sizes of fields favoring a change and of those opposed. This presentation is on the basis only of the number of people affected. Other aspects of the situation, such as the value and importance of the products of various fields and the manner in which they are bound up with weights and measures must also be given due consideration.[1]

C. EFFECT ON AMERICAN INDUSTRY GENERALLY AND ON FUNDAMENTAL MECHANICAL STANDARDS OF SUBSTITUTION OF METRIC FOR ENGLISH SYSTEM.

The survey in Chapter VIII of various specific manufacturing industries serves to indicate how intimately weights and measures are tied up with the products of manufacture and how widely English units are used in various industries the world over. In textiles the English yarn counts (yard-pound) are used in practically every country, especially in the cotton industry. In metal products English machine standards, based on the inch, predominate even in metric countries. In food products weights and measures are used mainly in packing and labeling and follow the customs in the various countries carrying on canning industries, the tendency in the United States being to label cans in both English and metric measures. In lumber, the inch and foot (mainly English but including other natural inch systems) prevail almost universally in the cutting of boards. In paper and printing type sizes have been standardized in the United States, France, and elsewhere on the basis of the inch. In the chemical industry the metric system is used in experimental work, but hardly at all in chemical production, the machinery employed being made largely to English measurements even in metric countries.

It has been brought out also, through an examination of replies to the board's questionnaire, that there is a decided opposition to a change to the metric system among manufacturers in the United States. The textile industries expressed themselves as completely satisfied with the present system of weights and measures and as opposed to efforts to change it. Over 90 per cent of the metal-products industry registered decided opposition to a change. The food-products industry showed similar opposition. The lumber industry was likewise opposed and emphasized the "great confusion and incalculable expense" that would result. The paper and printing, automobile, railway car, shipbuilding, and implement and vehicle industries also went on record as decidedly adverse to any change.

The manufacturing field, employing as it does over 10,500,000 workers, and producing commodities valued at something like $25,000,000,000 annually, is unquestionably one of the most important fields of industry in the United States. The indications are that a compulsory change to the metric system would profoundly affect many manufacturing liens, especially during the period of transition, which the experience of other countries suggests would be very long. The interests and desires of such an important field and the effect of a change in weights and measures upon it should naturally be carefully weighed in considering the advisability of a compulsory change.[2]

Metric contentions.—Metric proponents maintain that a change to the metric system would not necessarily mean the destruction and discarding of the pres-

[1] P. 118.
[2] Pp. 100–101. See also pp. 97–100 on "Relation to question of change in United States."

ent system of mechanical standards or the equipment embodying it; that it would involve in large part merely the expression of present standards in metric terms; and that in so far as any alteration or destruction became advisable, it could be effected gradually and without confusion as the equipment in question were out and had to be replaced.[1]

English answers.—English proponents contend, first, that all available evidence based upon the experience of other countries indicates that the substitution of metric designations for existing sizes and the actual replacement of English with new metric equipment is impracticable, and secondly, that if the United States is contemplating a change in systems it must face the fact of the destruction of existing mechanical standards. In addition, they insist that following the change there would necessarily be a long aftermath during which the mechanical industries of the country would suffer from a tremendous confusion and the laborious undertaking of rebuilding new standards in another system.[2]

D. EFFECT OF SUCH SUBSTITUTION ON THE GENERAL PUBLIC.

There is another effect * * * that the change would have which, as it pertains to transportation and retail trade particularly, is of paramount importance. This would have to do with changing the habits of not only those engaged in these fields but also of those that constitute the traveling and buying public. In 1910 there were about 71,500,000 people in the United States 10 years of age and over. Most of these in their everyday activities engage in traveling and in the retail purchasing of consumable goods. With trade practices as bearing on weights and measures changed by compulsory law, the habits of the entire buying and traveling public, as well as of those directly engaged in selling and transporting goods, would be affected.

In the United States a man buys a size 15 collar, the housewife a pound of butter or a yard of cloth. In a country in which the metric system is used in retail trade a man would have to call for his collar in terms of centimeters; the housewife would be forced to buy her butter in kilograms and her cloth in terms of meters. Generally speaking, the one method of purchase is as good as the other, since the designations used are of no intrinsic significance to the purchaser. The chief consideration here, however, is that the terminology employed should be familiar to both the buyer and the seller. In the United States if a man were asked whether he would rather call for his collars in inches or in centimeters or a woman if she would rather get her butter in pounds or kilograms, there is no question as to what the average purchaser would prefer.

In the four fields[3] treated in this chapter such little demand as exists for a change to the metric system comes from those engaged in wholesale trade, who, as has been noted, comprise a very small group, comparatively speaking. There is practically no sentiment at all in favor of a change to be found in the other fields discussed.[4]

E. COST OF SUCH SUBSTITUTION.[5]

Metric contentions.—Metric proponents contend in general that the cost of a change to the metric system has been greatly overestimated. Such a change would involve, they assert, merely the translation of literature and catalogues, which, in view of the existing metric literature, would not be difficult, and the replacement of present weights, measures, and scales, affecting chiefly the field of domestic trade, rather than any serious destruction of equipment.[2]

English answers.—English proponents claim since a compulsory change to the metric system under any form of compulsory law would necessarily entail the discarding or alteration of a large part of the basic mechanical equipment of the manufacturing industries of the country, compel the replacement of

---

[1] P. 173. For detailed metric contention and English answers on this point see pp. 173–180 of report. See also important consideration mentioned on pp. 50–51.
[2] P. 180.
[3] The four fields referred to are agriculture, mining, transportation, and trade, facts and arguments regarding which are found on pp. 66–77, 148–150, 169–170.
[4] Pp. 76–77.
[5] For detailed testimony regarding the cost of a change see pp. 180–188 of report.

scales and measuring instruments in use among all classes of people, and require a period of training in the use of the new system, which period would involve errors and reduce efficiency, the only result of the compulsory adoption of the metric system would be to drag the country into an enormous expenditure and waste without providing any compensatory advantages.[1]

F. PROBABLE LENGTH OF TRANSITION PERIOD AS EXPERIENCED IN SIMILAR CHANGE IN OTHER COUNTRIES.

Metric contentions.—Proponents of the metric system declare that in general the experience of other countries demonstrates that the difficulties involved in such a change are greatly exaggerated by supporters of the English system and that the people of the United States would adopt the new units without serious confusion after a relatively short transition period, especially if the legislation requiring the use of the metric system were limited at first to certain activities and gradually broadened in scope.[2]

Metric advocates assert also that in countries where the metric system has been adopted difficulty in making the change has been evidenced only among ignorant people and that the retention of ancient units in these countries and among such classes does not constitute an argument against a change. The mere fact, they say, that the use of ancient terms continues in certain isolated industries and communities carries no more weight than does the fact that we still retain Roman numerals on our watch faces or that the Gregorian calendar has not yet entirely displaced the Julian calendar or that older units remained in use for a generation after the adoption of our decimal currency in the United States.

In view of the simplicity and ease of use of the metric system as previously set forth, they maintain, it is unlikely that any class of the educated population in the United States would find the system difficult to acquire in a short time. Rather would the uniformity and standardization which the metric system of measures would bring, they continue, make the people of the country welcome such a change and adapt themselves to it quickly.[3]

English answers.—English proponents maintain on the contrary that the experience of other countries and a consideration of the situation in the United States show that the change to the metric system would involve enormous disturbance to the every-day habits and customs of the whole buying and traveling population of the country, and would create untold confusion in business practices which would require a long transition period to overcome, no matter how compulsory legislation were applied.

In the first place, the assertion of prometrics that a change in other countries has been easily and quickly made is flatly denied. To show the general difficulties involved in a change as indicated by the continued and extensive use of the old units in metric countries, statements from United States consuls stationed in these countries and from individual engineers, commerce officials, and others who have made a study of the use of weights and measures in such countries are cited.

In further answer to the metric contention that various metric countries have easily and quickly secured by the adoption of the metric system uniformity of weghts and measures and the suppression of the many and varied local systems in the country, proponents of the English system call attention to two facts. First, they point out that even where a substantial degree of uniformity exists in a metric country to-day, experience of all metric countries proves that a long transition period ranging from 25 to 100 years is necessarily involved in making a change in systems, during which period the country is forced to contend with a confusion résulting from the extensive use of local measures along with the attempted enforcement of the compulsory metric law. France is pointed to as a preeminent example of such difficulty, confusion, and lack of uniformity. In the next place, proponents of the English system point out that whereas most metric countries had no national uniformity of weights and measures before the metric system was adopted, the United States now has and has had for many years a standardized and thoroughly unified system which is solidly incor-

[1] P. 188.
[2] Pp. 161–162. For detailed arguments based on experience of other countries see pp. 162–164.
[3] Pp. 163–164.

porated in its manufacturing and basic industries and business life, and deeply ingrained in the habits of the people. For these reasons, English proponents point out, if it has been difficutl to suppress older units in other countries which have adopted the metric system, still greater difficulty is to be expected in the United States.[1]

G. NEED FOR COMPULSORY LEGISLATION TO EFFECT SUCH A CHANGE.

Metric contentions.—Metric proponents contend that the manner in which the change is brought about could be adjusted so that it would take place in easy stages and cause little confusion or inconvenience to any of the various interests of the country. By first requiring its use in Government departments and in the schools, they say, manufacturers and the public generally could gradually familiarize themselves with it and adapt themselves to it. Following this, its use might be extended by legislation to domestic trade. In this way the manufacturing field would be given ample time and inducement to adopt the system voluntarily.[2]

English answers.—English proponents maintain that the experience of other countries conclusively shows that the difficulties arising from a drastic change in the habits of the people, from the necessity of revising the technical literature of the country, and from the confusion incident to the use of two systems side by side during the long period of transition necessary, would be insurmountable no matter what forms of compulsory law were adopted to compel the use of the metric system, and the fact that compulsory law is invariably required to bring about a change, as shown by the experience of other countries, demonstrates that the system has no advantages which would lead people to adopt it voluntarily.

In any case, English advocates contend, no compulsory law of any kind would be necessary if the metric system possessed the advantages claimed for it. It is already permissible, they point out, for any one who wishes to use the metric system to do so, and if the system had any merits which recommended it conclusively to the public, no difficulties would long stand in the way of its adoption and no gradual extension of compulsion would be needed. Standards of screw and pipe threads, for instance, were freely adopted when the advantages of them were recognized. The manufacturers have voluntarily scrapped thousands of dollars worth of machinery when it was deemed desirable to do so. In short, if the metric system were a superior system it would long since have come into use without the necessity of compulsory law.[3]

H. NATURE AND EXTENT OF DEMAND FOR A CHANGE.[4]

Metric contentions.—Metric proponents maintain that there is a strong and growing demand for a change to the metric system in this country. This demand is evidenced, they say, among all classes of people, a growing tendency being noted among the manufacturing industries to favor this system in place of the English. Long lists of names are presented in connection with these contentions, and the opinions of a number of manufacturers are also cited. Finally it is contended that what is true in the United States is likewise true in Great Britain, viz, that there is a widespread demand there also in favor of a change to the metric system.[5]

English answers.—English advocates deny that there is any demand worthy of serious consideration in favor of a change to the metric system in this country and point out that what little demand exists comes from teachers, scientists, and a few others representing in all an extremely small group, not more than one-tenth of one per cent of the whole population—and that even this group is divided. Metric proponents, they say, have simply been exploiting a limited sentiment to make it appear that a strong demand for a change exists, have left the large and important fields of agriculture, mining, transportation, and trade entirely out of consideration, and have ignored the extremely im-

---

[1] Pp. 165, 168–169. For detailed testimony as to experience of other countries, see pp. 16–168.

[2] P. 164. For detailed metric arguments and testimony on both sides regarding the experiences of other countries, see pp. 161–172.

[3] Pp. 172–173.

[4] For detailed arguments on both sides, including actual testimony and resolutions of manufacturers, associations, etc., see pp. 189–198.

[5] P. 189.

portant fact that manufacturers and business men generally are strongly opposed to a change.[1]

I. COMPARISON OF METRIC AND ENGLISH SYSTEMS FOR UNIVERSAL USE.[2]

Metric contentions.—Metric proponents contend that the use of the metric system and opinion in favor of it is steadily increasing in Great Britain and the United States, that there is a growing realization that the English system is crude and confusing and that the adoption of the metric system in these countries would eliminate this confusion and secure world uniformity.[3]

English answers.—Proponents of the English system repeat their denial, elaborated in the preceding chapter, that there is any demand worthy of serious consideration in favor of the metric system in Great Britain and the United States, and contend that, on the contrary, there is increasing indication that the English system, with slight modifications, is coming to be fully recognized as the ideal system.[4]

Regarding the assertion that there is considerable confusion among the units of the English system and that people are increasingly realizing this, proponents of the English system insist that this is absolutely false, that as a matter of fact there is no ambiguity between dry and liquid measures and avoirdupois and troy weights, since these are used only with respect to certain well-defined classes of material known to everyone; i. e., the troy pound and the apothecaries' pounds are never used in commerce; the troy ounce is the unit used for weighing gold and silver and the apothecaries' weight does not exist outside of the prescription department of drug stores. Furthermore, where the several States have passed statutes establishing certain seemingly arbitrary and irregular measures, advocates of the English system continue, these relate, in the main, to the measurement of agricultural products, such as wheat, potatoes, apples, etc., and most of them consist in defining the weight per barrel or bushel or peck. Obviously, they say, these differences in weight are inherent in the nature of the merchandise to be measured, varying with its specific gravity, and have nothing to do with any system of weights, measures, or volume. What is needed with respect to merchandise and other products also is a more thoroughgoing standardization of the practices employed, and this applies with even more force where the metric system is used than in English-speaking countries, since in the latter the process of standardization has proceeded much further than in metric countries.[5]

NATIONAL INDUSTRIAL CONFERENCE BOARD.

NOVEMBER 14, 1921.

The CHAIRMAN. Have you anything else to offer, Mr. Stutz?

Mr. STUTZ. No, sir.

The CHAIRMAN. That concludes, then, the presentation on behalf of the opponents of this proposed legislation?

Mr. STUTZ. Yes, sir.

The CHAIRMAN. Is there any rebuttal to be offered?

Mr. CROCKER. Yes, sir. As soon as we are able to examine the testimony which has been presented by the opposition, when it is all in, we would like opportunity to put in a brief rebuttal.

The CHAIRMAN. Very well. The time for that can be arranged later. The reporter will insert at this point a statement by Mr. Russell on the general subject of the standardization, decimalization, and correlation of our common weights and measures. The subcommittee will now adjourn.

(The statement is here printed in full, as follows:)

A STANDARD DECIMAL SYSTEM OF WEIGHTS AND MEASURES FOR THE UNITED STATES.

One of the primary and, indeed, imperative needs of the commerce of the United States is the establishment of a standard decimal system of weights and measures.

---

[1] P. 198.
[2] For detailed arguments under this heading, see pp. 199–211 of report.
[3] P. 207.
[4] P. 208.
[5] P. 209.

INHERENT DEFECTS OF THE METRIC SYSTEM.

I do not refer to the metric system which was defined by a Federal statute in 1866 and in all the intervening years has not become of any importance in the commerce of the country. The metric system has had its day in the United States. It has been weighed in the balances and found wanting. The country does not want it. The plain and inexorable fact is that the metric system is impractical, that the metric units are not of the proper magnitudes for use in commerce or in the mechanical and liberal arts, and that this defect of the metric system can never be overcome. This is the reason why the metric system has made no headway anywhere except by the compulsion of arbitrary legislation. It is an absolutely futile thing to attempt to force the commerce of a great country like the United States into a metric strait-jacket.

The decimal correlation of the units is the only merit of the metric system. The utility and convenience of a decimally related system of weights and measures is to be admitted. The processes of arithmetic are decimal. A system of duodecimal arithmetic would require 12 digits—1, 2, 3, 4, 5, 6, 7, 8, 9, X, H, 0. But we have decimal arithmetic, and the decimal relation, therefore, is the most convenient relation between the units of measurement. The advantages of the decimal arrangement are exemplified by the fact that American engineers have decimalized the foot, that American mechanics have decimalized the inch, and that American physicists have decimalized the pound. The difficulty, however, is that the foot, inch, and pound are not themselves decimally correlated and therefore can not be comprised in a standard decimal system.

THE TRUE WATT SYSTEM OF MEASURES.

The fact of fundamental significance in this matter is that the cubic foot of water at maximum density weighs precisely 1,000 ounces (avoirdupois), from which it follows that we may define the ounce as the cube of the tenth of the foot of water at maximum density. This gives us a volumetric definition of the ounce and at the same time defines a new linear unit, the tenth of the foot, which we may denominate the decimal inch and from which we directly derive the decimal square and the decimal cube. This very pertinent fact was pointed out by James Watt, the great British mechanician, in 1783, and was also stated by Jefferson in 1790 in his report of a plan for establishing uniformity in the coinage, weights, and measures of the United States. Jefferson's decimalized dollar was adopted for our coinage. Jefferson's decimalized foot would have been adopted had he not proposed to change the foot to the equivalent of 11.74 English inches, defined as the fifth of the pendulum rod beating seconds.

The present plan is to decimalize the English foot. It was James Watt who had the original conception of a complete decimally related system of weights and measures, with the unit of weight and all other units derived from the unit of length, and Watt's proposal was expressly to make the English foot and the ounce derived from the tenth of the foot, the bases of his decimal system. In Watt's own langauge, "As to the precise foot, * * * the common English foot may be adopted * * * which has the advantage that the cubic foot is exactly 1,000 ounces, consequently the present foot and ounce would be retained, * * * the inconvenience of changing all the foot measures and things depending on them, would be much greater than changing all the pounds, bushels, gallons, etc. I therefore give the preference to those plans which retain the foot and the ounce. * * * Let the philosophical pound consist of 10 ounces or 10,000 grains; the ounce to consist of 10 drachms or 1,000 grains; the drachm to consist of 100 grains. Let all elastic fluids be measured by the ounce measure of water, by which the valuation of different cubic inches will be avoided, and the common decimal table of specific gravities will immediately give the weights of those elastic fluids." Or, as it was stated by Dr. S. W. Stratton, Director of the Bureau of Standards (Miscellaneous Document No. 21), "James Watt suggested that all units of weight and measures be derived from a single unit of length. This was the basic principle of the metric system." But the metric system is only the impractical counterfeit or imitation of the real decimal system of weights and measures conceived by James Watt. The French communists appropriated Watt's decimal idea, but did not give it the practical application he had in mind. They applied Watt's idea, on the contrary, to their arbitrary meter, which they claimed was the ten

millionth part of the quadrant on the meridian passing over France, but they miscalculated the actual length of the quadrant by nearly a mile. And it should be remembered, moreover, that standard measures must be convenient to the arts instead of being accommodated in some fanciful fashion to nature, in which all quantities are relative and none definite.

The meter is not what it "scientifically" pretends to be, nor is it otherwise useful in the arts as compared with the foot and its fractions which have been established by custom and have the sanction of long usage, convenience, and utility. The foot, therefore, as the base for a decimal system of weights and measures is in every way superior to the meter.

NATURAL MAGNITUDES FOR ARTIFICIAL MEASURES.

The natural magnitudes that have been proposed as bases for artificial mensuration are the great circle of the earth of which the meter of 39.37 inches is fancifully claimed to be the 40-millionth part; the second pendulum which at London is 39.1398 inches and at Washington is 39.0968 inches; the second "rod" of 58.72368 inches, one-fifth of which Jefferson proposed as the American foot which was to be decimalized to 10 inches, 100 lines and 1,000 points; and the acceleration of gravity per second, of 32.16 feet or 385.95 inches, one-tenth of which would be 38.592 inches. But while an original linear standard could be approximately accommodated to any or at least some of these "natural" magnitudes, it could not after primary determination, as a practical matter, be periodically tested or tried by these natural magnitudes. The original linear rod would be the standard to which all duplicates would be referred for comparison. In other words, an artificial, invariable metalic rod would be the standard and that is precisely what we may have in the standard foot. The foot has been determined to be .30046 of the second pendulum at London and to be .3048 of the standard meter refrigerated at Sevres. And this is quite as precise and definite as though the foot were an aliquot part of the pendulum or of the meter. The Bureau of Standards at Washington should become the repository of the New American decimal standards.

If the meter of 39.370113 inches were in any wise to be preferred to the foot, the yard of 36 inches would also be preferred to the foot. The fact, however, is otherwise. The foot is generally preferred to the yard in practice. The use of the yard has even now become limited to a few special trades.

THE FOOT, THE HISTORIC LINEAR STANDARD.

The foot has at some time been the standard linear measure of every civilized nation both of the ancient and the modern world. The foot of Egypt was equal to 12.16 English inches; the pes of Rome to 11.65 inches; the pous of Greece to 12.123 inches; the pied of France to 12.79 inches; the foute of Russia to 12 inches; the chih of China to 12.5 inches; the shaku of Japan to 11.928 inches; the fuss of Germany to 12.36 inches; the fuss of Vienna to 12.444 inches; the fot of Norway to 12.35 inches; the fod of Denmark to 12.36 inches; the fot of Sweden to 11.69 inches; the pie of Spain to 11.4 inches; the pe' of Portugal to 12.96 inches; and the pe' of Brazil to 12.96 inches. It is the English foot, however, of 12 inches as we know it, which has become the standard foot of the world.

The standard decimal rule of the foot is graduated into tenths, hundredths, and thousandths which are denoted respectively as decimal inches, lines, and points. There are a thousand points to the foot. The use of multiples of the point will in practice avoid any confusion with the common inch or its fractions. The point is about as fine a graduation as can be conveniently indicated upon a steel rule. The point is three and a third times as fine as the metric millimeter. The capacity of the point for the elimination of fractions in computations is therefore 3⅓ times as great as that of the millimeter.

The line or hundredth of the foot is as fine a graduation or unit as may be plainly numbered or figured upon a scale or rule. The numbering of the lines of the foot from 1 to 100 will permit with perfect facility the measuring directly to lines or hundredths of the foot. The line ought really to become the prime mechanical unit and should be divided by the micrometer into 100 parts for precision measurements and tolerances.

Decimal multiples of the foot may also be prescribed; the pole of 10 feet; the chain of 100 feet; and the league of 1,000 feet. This will make a mile 528 poles, a half mile 264 poles, a quarter mile 132 poles, an eighth mile (furlong)

66 poles, a sixteenth mile (20 rods) 33 poles, (and a thirty-second mile (10 rods) 16.5 poles, which makes the pole readily adaptable for land measurement and surveying.

WEIGHTS DERIVED FROM THE FOOT.

The ounce, as the standard weight is defined as the decimal cube of water at maximum density and is divided into 1,000 grains as originally proposed by James Watt. It may be preferable to denote the new standard grain or thousandth of the ounce as the "mill" (m.) to distinguish it from the common grain as used in Troy weights, and until the common grain becomes obsolete. The tenth of grain might be denoted the mite as was proposed by Jefferson. The common grain, of which there are 437½ in an avoirdupois ounce is obviously an impractical fraction of the ounce and may well be supplanted by decimal fractions of the standard ounce. Scales are now offered to the trade with beams graduated to tenths, (d.) and hundredths (c.) of the standard ounce. The practical retail scale should have a beam graduated to 1,000 ounces. Modern scales with charts or dials graduated to ounces may readily have charts marked to indicate 10, 20, 30, 40, 50, 60, 70, 80, 90, 100 ounces, etc. The ounce should become the weight unit for retail trade. The Troy ounce is now used in all denominations up to 1,000 ounces and weights in these denominations are offered to the trade. The same use should be made of the avoirdupois or new standard ounce.

Decimal weights of the ounce may, of course, be used on any balance. These decimal weights should be in mills or thousandths of the standard ounce and should be made in the following denominations: 1 mill, 1/1000; 10 mills, 1/100; 100 mills, 1/10; 125 mills, ⅛; 250 mills, ¼; and 500 mills, ½. Multiple weights of the ounce should be in denominations of 1, 2, 5, 10, and 20 ounces for use on balances, and scale poises should be made to indicate 50, 100, 200, 500, and 1,000 ounces. The 10-ounce weight might be denominated the mark, and the 100-ounce weight might be denominated the stone, as was proposed by Jefferson. James Watt himself expressly proposed a 10-ounce international pound. The pound of 16 ounces, however, although not decimal, is so well established, that this word should not be used to designate any other weight.

MEASURES DERIVED FROM THE FOOT.

The bushel as used in international commerce has already become a weight unit of 60 pounds or of 960 ounces, which is the standard weight of a bushel of wheat. Sound plump wheat, moreover, will weigh full 1,000 ounces or 62½ pounds. The bushel weight should be defined as 1,000 ounces, which will standardize the weight of the bushel as used in trade.

The farm and orchard products which were formerly sold by the bushel measure, are now generally sold in boxes, barrels, crates, hampers, baskets, or other containers which do not have any relation to the bushel measure and which for certainty ought to be defined in terms of the foot cube. The new decimal standard measure for commodities is the foot cube or tub as it is proposed to call it.

Cargo space in ships and freight space in railroad cars and in warehouses are now generally indicated in foot cubes. Water in reservoirs, or flowing in aqueducts, is now measured in foot cubes or foot cubes per second as the case may require. Gas and water from service mains are measured and sold in foot cubes. The import duty or tariff on "grapes in barrels or other packages is 25 cents per cubic foot of the capacity of the barrels or packages." The tariff duties on lemons, limes, oranges, grapefruits, shaddocks, and pomelos are also prescribed upon a cubic-foot basis (tariff act 1913, Schedule G, 219–220). The foot cube as a commodity measure has thus received the approval of Congress. The foot cube or keg is just 8 decimal cubes or ounces more than four-fifths of a bushel. The bushel measure, as long as it may be retained, ought, for the sake of uniformity and convenience, to be defined as 2,160 cubic inches, 1,250 decimal cubes, or 1¼ cubic feet. The standard bushel would then be equal to 12 by 12 by 15 inches, whereas the present American or Winchester bushel is equal to 12 by 12 by 14.9334 inches. The increase in this one dimension would be about one-sixteenth of an inch. Boxes and crates for fruit and vegetables could then be readily cut to accommodate either foot cubes or bushels.

The foot cube of wheat or potatoes would weigh full 48 pounds; a very convenient trade quantity. The tub as now used in the butter trade has the approxi-

mate volume of 1 cubic foot. The foot cube or the "tub" as it may be called, should therefore become the universal primary measure for all commodities sold by volume, and the decimal cube with its multiples the secondary unit for such purposes. The tub, which is the volume of the foot cube, would, in cylindrical form, have a base of 1,000 points diameter and a depth of 1273.2 points, and the gallon which is the eighth of the tub, would, in cylindrical form, have a base of 500 points diameter and a depth of 636.6 points. The advantage to the people of being able to visualize the quantity of an ounce by reference to the cube of the decimal inch, and to visualize the tub by reference to the foot cube is of itself a noteworthy accomplishment. The tub is divided decimally into tenths or pots, hundredths or pints, and into thousandths or decimal cubes, and binately into half tubs, pecks and gallons.

DECIMAL AND METRIC MEASURES.

The foot in the American decimal system is divided into tenths, hundredths, and thousandths, just as a meter is divided into tenths, hundredths, and thousandths; the cubic foot of water is 1,000 ounces, just as the cubic decimeter of water is 1,000 grams; and the cubic foot is made the standard commodity measure in the decimal system, just as the cubic decimeter or liter is the standard commodity measure in the metric system.

It is to be observed that in the new American decimal system it is the foot cube that is the tub and the foot cube of water that is the standard weight of 1,000 ounces; that is to say, the standard measures of volume and of mass are the cubes of the standard foot, whereas in the metric system the liter is the cube not of the standard meter but of the decimeter, and the kilogram of 1,000 grams is not the cubic meter but is the cubic decimeter of water. The decimeter itself is already obsolete. It takes no argument to demonstrate that the better arrangement is that of the new decimal system. It speaks for itself.

The physicist and chemist in the laboratory do not deal with lines but rather with volumes and weights, with units of mass and gravity. In other words, the laboratory is primarily concerned with grams and not meters. With apothecaries' weights, avoirdupois weights, carat weights, and troy weights, none of which have a volumetric definition and none of which are decimalized either in divisions or multiples, and which may be said to constitute diversion and complexity in themselves, it is easy to understand why physicists and chemists have turned with some willingness to the decimalized gram defined volumetrically as the cubic centimeter of water. But the new decimalized ounce, defined volumetrically as the decimal cube of water not only affords all the decimal perfection of the gram but is intrinsically superior as a practical weight or mass magnitude. The decimal cube is identical with the British fluid ounce of the laboratories.

The utility of the gram in chemistry arises solely because it has a volumetric counterpart, is decimalized, and is internationalized. There is not much signification in its particular magnitude, because it is the practice, even in the laboratories to use multiples of the gram and of the cubic centimeter. In general commerce, however, the gram itself is a negligible quantity and is imponderable on the ordinary trade scales. The division of the gram into a thousand milligrams may be logical in the metric sense, but is an absurdity in common sense.

The foot is a practical linear standard, the meter is not; the decimal inch, or tenth of the foot, is a simple and primary decimal division of the linear unit, the centimeter, the centesimal, or hundredth of the meter, is not; the ounce or decimal cube of water is a practical trade weight, the gram or cubic centimeter of water is not; the foot cube is a practical trade measure for commodities, the liter is not.

The metric system is, properly speaking, not a decimal, but is a centesimal system. It is commonly called the centimeter-gram system. That is what it really is. It is only the metric centimeter and its derivatives, the cubic centimeter and the gram, which are used to any extent in this country. These alone have the merit of being convenient laboratory magnitudes. Now, the third of the decimal inch is 33.3 points and the centimeter is 32.8 points, so that if we define the American centimeter as the third of the decimal inch we only increase the length of the French centimeter by half a point. If the centimeter with its derivatives, the cubic centimeter and the gram, has any

special utility because of its particular magnitude, it would be equally and indeed more useful to be the precise third of the decimal inch. Three centimeters would then equal 1 decimal inch, 27 cubic centimeters a decimal cube or fluid ounce, and 27 grams an ounce. The American centimeter or "ameter" could be indicated am., the American cubic centimeter or "acube" could be indicated ac., and the American gram or "agram" could be indicated ag. The "agram" would exceed the "gram" by only three-fourths of a grain. The difference would be one-twenty-seventh of a gram. The ordinary drug and chemical balance is not sensitive below one-tenth of a gram and many balances made for the chemical trade are not sensitive below one fifth of a gram. We could thus bring these laboratory units into correlation with the new American decimal system. The rest of the metric system, with all its entomological nomenclature, should be completely discarded in our country.

There is no use for any practical person to play with the metric conversion tables. If one wants to be a metric faddist, let him use the metric units, but there is no more sense in trying to convert our common or English measures into metric equivalents, than there is to try to convert the English language into Esperanto.

DECIMAL COINAGE.

The trade dollar defined by the act of February 12, 1873, was 420 grains troy or precisely 96 per cent of the avoirdupois ounce in weight. The present dollar of 412½ grains is 94 per cent in avoirdupois ounce in weight. The slight increase of weight required to make the silver dollar a precise ounce avoirdupois of silver 900 fine would really be imperceivable. The troy ounce of silver at 60 cents, the present market price, would coin $1.22, and the seignorage or coinage profit would be 100 per cent. At $1 an ounce troy, the profit of coinage would be 22 per cent. We ought to have a standard-ounce silver dollar with the ounce itself divided decimally into dimes (d.), cents (c.), and mills (m.), analogous to the decimal divisions of the dollar.

The standard silver dollar of 1 ounce avoirdupois in weight should be divided decimally, and the silver and minor coins should have the value of 1, 2, 5, 10, 20, 50, and 100 cents, respectively. The 20-cent coin should be called the franc or American franc. We should also denominate our $5 gold piece the pound or American pound. We would thus have 5 francs equal 1 dollar, and 5 dollars equal 1 pound. Upon this basis Great Britain and France could bring their shillings and pounds and francs into correlation with our American dollar. The silver weights of shillings and quarters should be assimilated to the fourth of the avoirdupois ounce and the silver weights of francs and 20-cent pieces should be assimilated to the fifth of the avoirdupois ounce. As these silver coins have value because of their gold redemption, the silver weights can be changed without affecting the trade value of the coins.

There remains, of course, the assimilation or correlation of the gold weights of the various national coins. This, for the sake of uniformity and the facility of foreign exchange, should be accomplished. The following table exemplifies the close approximation of the pure gold weights of the important national coins:

	Troy grains.		Troy grains.
1 dollar, United States	23.22	5 francs, Belgium	22.4
2 yen, Japan	23.148	5 francs, Switzerland	22.4
2 rubles, Russia	23.895	5 leu, Bulgaria	22.4
5 korona, Austria	23.52	5 marka, Finland	22.4
2½ guilders, Holland	23.332	5 drachma, Greece	22.4
4 krone, Norway	24.888	5 lira, Italy	22.4
4 krone, Sweden	24.888	5 leu, Roumania	22.4
4 krone, Denmark	24.888	5 dinar, Serbia	22.4
4 shillings, England	22.6	5 paseta, Spain	22.4
4 marks, Germany	22.124	5 boliver, Venezuela	22.4
5 francs, France	22.4		

It is obvious that the way to bring these coins into correlation is to bring them into aliquot relation to the American dollar. A 24-grain gold dollar would be precisely one-twentieth of the troy ounce and would make gold $20 an ounce flat. Or the assimilation of the coinage of the nations on the basis of 21.875 troy grains for the gold dollar would give a gold dollar of precisely one-

twentieth of the new standard ounce or of 50 standard grains. A standard ounce of gold would be $20, and the coinage ratio with silver would be 20 to 1.

Standard gold weights for coins are only second in importance to standard uniform weights and measures.

CONGRESSIONAL DEFINITION OF DECIMAL STANDARDS.

It is perfectly obvious that the definition of these standard decimal units by an act of Congress would not be a radical departure from our present common measures, but would rather bring the same into decimal relations and afford us all the advantages of a true and complete decimal system without introducing new basic units. In practice, linear magnitudes within the foot would be indicated in points (thousandths), weight magnitudes within the standard weight would be indicated in ounces (thousandths), and weight magnitudes within the ounce would be indicated in grains (thousandths). Halves, quarters, and eighths may be precisely denoted in thousandths, and this is the practical limit for the uses of binate fractions. There is no need to prescribe decimal multiples of the unit. Without any specific designation of decimal multiples of our common measures, the common system is decimal in dealing with multiples. Thus lumber is sold by the 1,000 feet, flour is sold by the 100 pounds, and sugar and salt may be bought in 10-pound bags. Wheat, corn, potatoes, etc., are usually sold upon 1,000, 100, or 10 bushel orders. It is only in the field of fractions that decimalization is really required, arithmetic itself being decimal in dealing with integers or units. Such a system would be bound to make its way in the British dominions and then into Latin America, Russia, China, and Japan, and would eventually be recognized in Continental Europe. We have all the time to come before us, and we should get upon a rational and permanent measuring basis in our commerce both domestic and foreign. We are now the greatest exporting and credit country in the world. Let the other countries take our measures and our money. It is absurd that we should go to inbred, constricted Continental Europe for our measures, weights, or money.

Goods packed for export upon a agram or ammeter basis, or upon a 100 ameter (or centimeter) basis, would be quite as acceptable in South America as goods packed or required to be packed upon a metric basis, as the difference would not be discernible but with an advantage in favor of the American measures because of the slight excess in size. This would be unobjectionable and would only be a makeweight in price competition. One-half of the population of Latin America, including the West Indian Islands, is in Brazil and Mexico. None of the other Latin American countries are as important commercially or otherwise as some of the States of the Union. The Latin American countries adopted the metric fad, one after another, like a flock of sheep, in 1866, since which time the metric measures have had a scrambling application in those countries.

It is simply preposterous to propose that we change the basic weights and measures of the United States to accommodate Latin American trade. Latin America can more readily take our measures and should do so.

METRIC PROPAGANDA.

The widespread propaganda for the exclusive use of the metric system in America and Great Britain is also one of those things "made in Germany." Under date of Berlin, February 27, 1914, Sir W. E. Goschen, the British ambassador, sent this dispatch to Sir Edward Gray, London:

"I have the honor to transmit herewith a report on the establishment, under Government control of a powerful secret association for the purpose of influencing the foreign press in the interest of the German export trade and the spread of German influence generally."

This report was published by the British Government as Miscellaneous Document No. 9, September, 1914. The report deals with plans for the organization in March, 1914, of a powerful German trade and propaganda organization to be called the "Association for World Commerce."

The war intervened and of course interfered with the immediate work of this Weltverein for German trade, but only four months after the armistice, in March, 1919, the World Trade Club appeared out of the blue sky in the office of a mailing agency in San Francisco, and through this publicity agency has circularized every lawyer, doctor, merchant, chief, teacher, preacher, professor, and periodical in the United States, Canada, and Great Britain, advo-

cating the exclusive use of the metric system in these countries. Thousands of persons signed petitions in response to these circulars. Many of these persons were of course merely metric hobbyists. Metricitis, like socialism and single-taxism, may become a mental affection. The metric crank is like the others. There is no use trying to divest him of his pet obsession. But this metric propaganda itself is just a meritricious scheme to open the markets of the United States to the metricized merchandise of Germany, and to handicap and thwart our own merchants in their own markets, in the confusion which would inevitably result from the arbitrary imposition of the metric system upon our industries and our commerce. This propaganda is procured and promoted by Dr. Albert Herbert, an ubiquitous individual of German origin, who, as stated in one of his official publications, knows North and South America "from Alaska to Tierra del Fuego; he has traded on about every island in the Pacific." The Germans favor the metric system for North America just as they favor the metric system in South America, and for precisely the same purposes.

This metric propaganda is replete with misrepresentations and false suggestions. One of its principal features is the false claim that James Watt was the founder of the metric system. The scheme seems to be to give the metric system a little British authority and respectability. To one who knows the peculiar German cerebration, this propaganda is very clearly German composition. Herr Herbert, proprietor of the World Trade Club, made one of those German blunders when he did not hire an American with an English name to write his propaganda. In one of the lurid booklets circulated by Herbert's World Trade Club and adorned with the pictures of Jefferson, Watt, and Franklin, there is published a report of the so-called American National Association of Manufacturers, signed by Albert Herbert himself as chairman, wherein it is said:

"In America Thomas Jefferson devised and submitted (July 4, 1786) a decimal system of weights and measures as good in every way as the metric. The trouble was, the then American legislators lacked the gumption to adopt it, and thus America lost the opportunity to lead the world in decimal weights and measures, though it led in decimal money by the adoption of a decimal dollar."

Jefferson proposed to divide the foot into 10 inches, 100 lines, and 1,000 points; to make the cubic foot, the bushel, and the cubic inch of water, the ounce. Even metric propagandists may tell the truth in moments when they are not conscious that it may be to their advantage to conceal the truth. The name World Trade Club has now been changed to World Metric Standardization Council. It is manned by the same hired men who were the front of the now defunct World Trade Club.

PRACTICAL DECIMAL UNITS.

There is a 4-foot mechanics' folding rule now being sold to the trade which is graduated on one side in inches and sixteenths and on the other side in tenths and hundredths of the foot. One side of this rule is marked "English"; the other side of the rule I would like to have marked "American." The catalogues of our large manufacturers of rules and tapes now show numerous tapes and rules with the foot graduated decimally in tenths and hundredths. It would be a simple matter to carry the graduations on linen tapes and wood rules down to twentieths of the decimal inch which only vary by one-fifth of a point from the sixteenth of the common inch, and to carry the graduations on fine steel rules down to thousandths or points. There is now a steel rule sold to the trade graduated in hundredths of the inch, which means 1,200 graduations to the foot.

The tenth of a point is as proper a tolerance in machine work as may be indicated by the micrometer. This minimum dimension might appropriately be denominated the mike. The millimeter is, moreover, an impractical magnitude to divide decimally for micrometric tolerances in the machine trades, the tenth of the millimeter being too coarse for a practical tolerance, and the hundredth of the millimeter being too fine for practical application of utility, even where precision measurements are required. Machine bolts which are now made to sixteenths of the inch could as well be made to twentieths of the decimal inch, with numbers running from 1 to 20, No. 1 having a diameter of one-twentieth, No. 2 of two-twentieths, No. 3 of three-twentieths, etc., of the decimal inch. The standard pitch for screw threads of eight to the inch is

as 1 to 10 $\frac{5}{12}$ points and may well be assimilated to 1 to 10 points, and be denominated as 10-point pitch. A new system of point pitches may be worked out. Wire and wire gauges should be defined and denoted in points.

The common inch will doubtless be retained for an indefinite time as a line and dimension measure in the mechanical and machine trade. The decimal divisions of the inch as employed in shop practice are exactly convertible into terms of the new decimal system, whereas they are not convertible with exactness of facility into terms of the metric system. But the cubic inch, having no proper relation to weights, ought in practice to be abrogated in favor of the decimal cube as a volumetric, capacity and mass measure, and the square inch should likewise give way to the decimal square for measuring planes and surfaces.

The foot is now the prime line unit for engineering, surveying, construction, and general application; the yard is the prime line unit of special application in textile trades; the inch is the prime line and dimension unit in the mechanical and machine trades; and the centimeter, or, rather, the cubic centimeter or gram, is the prime mass unit of the laboratories. There is a special yard system limited to the textile trades, a special inch system limited to the machine and mechanical trades, and a special centimeter system limited to the volumes and masses used in laboratory practice which are uniformly but samples or examples of small magnitude. These special systems may stand in their limited fields of application, but they will all, in the new decimal system, have an aliquot relation to the primary foot standard, including the centimeter, which is to be defined, under the name "ameter," as the third part of the decimal inch, thus bringing it also into aliquot relation to the standard foot without materially altering its magnitude. Order will thus be brought into the whole range and field of practical and scientific mensuration by the complete correlation of all units in or to the standard decimal system.

It is not proposed to interfere by legal interdiction with any of the common or customary measures. It is to be expected, however, that some of these will go into progressive obsolescence. It is only proposed to evolve a practical and correlated decimal system of weights and measures from our present common units for the accommodation of our commerce, industries, and manufactures. The people would be free to use the foot decimally, duodecimally, or binately, according to their own preference and convenience.

We already have the basic decimal units—the foot and the ounce. They are established by custom and by the laws of the States. We will have the foot as the basic linear measure for all time to come. Why, then, should we not increase and facilitate its utility by decimalization? There is no reason why we should not; there is every reason why we should do so. It is too late to abolish the foot; it is not too late to decimalize it. Congress has the constitutional power and the duty to fix the standard of weights and measures for the United States. Congress has never exercised this power. The demand of the day is that Congress establish a standard decimal system of weights and measures for the whole country. There is no other practical way to bring order into the measures employed in our domestic and foreign commerce. The new system would accommodate our commerce and could be put into actual use with facility. It only needs to be defined by a Federal law. Its general acceptance will follow without legal compulsion or penalties, but upon its intrinsic merits and the free will of the people of the country.

THE DECIMAL STANDARDS BILL.

The bill to establish a standard decimal system of weights and measures for the United States is appended hereto.

Section 1 comprehends the basic units of the proposed decimal system, the essential units of which are the foot, decimal inch and point, the decimal square, and the decimal cube.

Section 2 defines the standard weight—the standard ounce, the standard grain, and intermediate decimal weight units.

Section 3 makes the foot cube (tub) the standard measure for commodities. The cube measure is divided decimally into pints, fluid ounces or decimal cubes, and drams, and binately into halves, quarters, and eighths.

Section 4 brings the centimeter, cubic centimeter, and gram into correlation with the decimal inch.

Section 5 defines engineering and scientific units in which the weight or mass factor is to be standard weight instead of the pound. The prefix "petty" might be used before these units to indicate that the weight employed is the ounce instead of the standard weight of 1,000 ounces. The pound itself has no decimal relation to any other weight unit, and not being an integral part of the decimal system is not adapted as a factor in standard scientific decimal units. The bill does not define new electrical measures. It is believed, however, that electricity, both for lighting and for motors, should be sold in the power units defined in the bill. It is certain that new intensity, resistance, and energy units may be formulated with copper as the metal of resistance, with the ounce as the weight factor, and the dimension factor stated in points, which will be more practical than the present international volts, ohms, and amperes. But this problem is remitted to the electrical technicians.

Section 6 defines the important common measures in terms of the decimal standards, and also gives these common measures Federal recognition and confirmation.

Section 7 provides for a prototype foot to be derived from the British imperial yard, thus bringing the new American decimal system into correlation and agreement with the measures of the British Empire.

Section 8 repeals the law expressly authorizing the use of the metric system, but does not in anywise interdict the use of the metric system, but leaves the same in the status of legal toleration instead of express authorization.

Section 9 defines the meter as the equivalent of 39.370113 common inches, in agreement with the value of the meter as fixed by the British Board of Trade, thus destroying the captious contention of metricists that the American inch and the British inch are not identical.

Section 10 provides that the act shall go into effect on the 1st of January next following its approval.

A BILL To establish a standard decimal system of weights and measures for the United States.

Be it enacted by the Senate and House of Representatives of the United States of America in Congress assembled, That the primary linear standard for the weights and measures of the United States shall be the English foot as commonly used and established as a measure of length in the United States of America and in the British Empire.

The standard decimal graduations of the foot shall be the tenth, which shall be denoted the decimal inch; the hundredth, which shall be denoted the line; and the thousandth, which shall be denoted the point.

The square of the foot shall be denoted the foot square; the square of the decimal inch shall be denoted the decimal square; the square of the line shall be denoted the petty square; the cube of the foot shall be denoted the foot cube; the cube of the decimal inch shall be denoted the decimal cube; and the cube of the line shall be denoted the petty cube.

The pole is ten feet; the chain is one hundred feet; and the league is one thousand feet.

SEC. 2. That the standard weight shall be the weight of the foot cube of water at maximum density; the standard ounce is the thousandth part of the standard weight or the weight of the decimal cube of water at maximum density; the mark is ten ounces; and the stone is one hundred ounces.

The decimal graduations of the ounce are the tenth, which shall be denoted the dram; the hundredth, which shall be denoted the carat; and the thousandth, which shall be denoted the standard grain.

SEC. 3. That the standard measure for commodities shall be the tub, which is the volume of the foot cube. The common divisions of the tub are the half, which shall be denoted the half tub; the quarter, which shall be denoted the peck; and the eighth, which shall be denoted the gallon.

The fluid ounce is the volume of the decimal cube; the pint is ten fluid ounces; and the pot is one hundred fluid ounces. The decimal graduations of the fluid ounce are the tenth, which shall be denoted the fluid dram; the hundredth, which shall be denoted the scruple; and the thousandth, which shall be denoted the petty cube.

The capacity of all containers in which either liquid or dry commodities are packed for measure or sale by volume shall be indicated for liquids in tubs, pints, or fluid ounces, and for dry commodities in tubs or decimal cubes.

SEC. 4. That the American centimeter, or ameter, is the third part of the decimal inch and may be designated am.; the American cubic centimeter, or acube, is the twenty-seventh part of the decimal cube and may be designated ac.; the American gram, or agram, is the twenty-seventh part of the ounce and may be designated ag.; and the American liter, or aliter, is the volume of one thousand acubes and may be designated al.

SEC. 5. That the water flow unit is the flow of one foot cube of water in one second of time.

The work unit is the work required to raise one standard weight the height of one foot.

The power unit is the power required to raise one standard weight the height of one foot in one second of time.

The thermal unit is the heat required to raise one standard weight of water one degree of the scale of the Fahrenheit thermometer.

The pressure unit is the pressure of one standard weight upon the surface of one decimal square.

SEC. 6. That the common inch is the twelfth part of the foot; the yard is thirty-six inches; the fathom is six feet; the rod is sixteen and one-half feet; the furlong is forty rods; and the mile is three hundred and twenty rods or five hundred and twenty-eight poles.

The acre is one hundred and sixty square rods.

The pound is sixteen ounces; the ton is two thousand pounds, or thirty-two standard weights; the quarter is five hundred pounds, or eight standard weights.

The bushel measure is the volume of one thousand two hundred and fifty decimal cubes.

The quart is the volume of thirty-two decimal cubes.

The enumeration of the foregoing common measures shall not be construed to forbid the use of other common measures not defined in this act.

SEC. 7. That a standard foot bar derived from the imperial standard yard in the National Physical Laboratory at Teddington, England, and deposited in the Bureau of Standards, shall, at the temperature of sixty-two degrees Fahrenheit, be the prototype foot and the base of the measures and weights defined in this act.

SEC. 8. That section 3569 of the Revised Statutes is hereby repealed.

SEC. 9. That section 3570 of the Revised Statutes is hereby amended to read as follows:

"SEC. 3570. The meter is the equivalent of 39.370113 common inches, which equivalent shall be recognized in the construction of contracts and in all legal proceedings for establishing in terms of the weights and measures of the United States, the value of the weights and measures of the metric system."

SEC. 10. That this act shall take effect on the 1st day of January next following its approval.

A BILL To amend sections 3513 and 3515 of the Revised Statutes, prescribing the weights of the silver and minor coins of the United States.

Be it enacted by the Senate and House of Representatives of the United States of America in Congress assembled, That sections 3513 and 3515 of the Revised Statutes be, and are hereby, amended to read as follows:

"SEC. 3513. The silver coins of the United States shall be the dollar; the half dollar, or 50-cent piece; the franc, or 20-cent piece; and the dime, or 10-cent piece. The weight of the dollar shall be one ounce avoirdupois of silver, nine hundred fine; the weight of the half-dollar piece shall be one-half of an ounce avoirdupois of silver, eight hundred fine; the weight of the franc shall be one-fifth of an ounce avoirdupois of silver, eight hundred fine; and the weight of the dime shall be one-tenth of an ounce avoirdupois of silver, eight hundred fine.

"SEC. 3515. The minor coins of the United States shall be the nickel, or 5-cent piece; the penny, or 2-cent piece; and the half penny, or 1-cent piece. The weight of the 5-cent piece shall be one-tenth of an ounce avoirdupois of an alloy of copper and nickel, three-fourths copper and one-fourth nickel; the weight of the 2-cent piece shall be one-tenth of an ounce avoirdupois of an alloy of 95 per centum copper and 5 per centum of tin and zinc, in proportions determined by the Director of the Mint; and the weight of the 1-cent piece shall be one-twentieth of an ounce avoirdupois of an alloy of 95 per centum of copper and 5 per centum of tin and zinc, in proportions determined by the Director of the Mint."

American decimal system tables.

LINES.

10 points.....1 line.
10 lines.....1 decimal inch.
10 decimal inches.....1 foot.
10 feet.....1 pole.
10 poles.....1 chain.
10 chains.....1 league.

WEIGHTS.

10 grains.....1 carat.
10 carats.....1 dram.
10 drams.....1 ounce.
10 ounces.....1 mark.
10 marks.....1 stone.
10 stones.....1 standard weight.

MEASURES.

10 petty cubes.....1 scruple.
10 scruples.....1 fluid dram.
10 fluid drams.....1 fluid ounce.
10 fluid ounces.....1 pint.
10 pints.....1 pot.
10 pots.....1 tub.

Lines.		Weights.	Measures.
Point	.001	Grain	Petty cube (line cube).
Line	.01	Carat	Scruple.
Decimal inch	.1	Dram	Fluid dram.
Foot	1.	Ounce	Fluid ounce (decimal cube).
Pole	10.	Mark	Pint.
Chain	100.	Stone	Pot.
League	1,000.	Standard weight	Tub (foot cube).

Any of these measures may be tested or determined by the volume of the corresponding weight of water.

There can be no valid objection to the enactment of the decimal bill. It is to be expected that metric partisans will make captious objection to any legislation which does not promote the impossible metric hobby, but they have really not the right to object to the improvement of our present system of common weights and measures. The metric system is now defined by section 3570 of the Revised Statutes of the United States. The decimal bill does not affect this section of the statutes, nor interdict the voluntary use of the metric system. There should be no further Federal legislation enacted upon the subject of the metric system.

The decimal bill is definitive and directory. It prescribes no penalties. Surely Congress commanded by the Constitution to establish standard uniform weights and measures for the United States, ought to do as much for our common measures as it did for the metric system by the act of 1866; that is to say, to define, decimalize, and standardize our customary measures for the commerce of the country.

EXCERPTS FROM CORRESPONDENCE BY MR. RUSSELL DISCUSSING MEANS FOR THE SIMPLIFICATION AND COORDINATION OF OUR COMMON SYSTEM OF WEIGHTS AND MEASURES.

DECEMBER 6, 1921.

C. C. STUTZ, *Secretary American Institution of Weights and Measures, 115 Broadway, New York City.*

DEAR MR. STUTZ: I know that you fully comprehend the plan I have in mind to decimalize the foot and to derive the other weights and measures from the foot. New prototype standards will have to be provided. The plan may be epitomized as follows:

A standard foot divided into 1,000 points; a standard cylindrical measure holding the volume of a foot cube, and divided into 1,000 fluid ounces (decimal cubes); and a standard weight equal to the foot cube of water at miximum density and divided into 1,000 ounces, the ounce in turn to be divided into 1,000 grains.

Decimalization of the units by thousandths will perfectly accommodate the binate fractions, halves, quarters, and eighths and the decimal fractions tenths and hundredths. The completion of the plan would likely require that some of these fractions be given special denominations.

Decimalization upon the yard would be impracticable and would be but a poor imitation of the metric system. Decimalization upon the inch would

be impossible because neither the inch nor its decimal multiples would have any simple relation to the higher linear units, the foot, yard, fathom, rod, furlong, and mile. Decimalization upon the foot is the only basis which can perfectly accommodate the situation both as to weights and measures. This would perfectly meet the metric contention as to decimalization, as to the corelation of the units of mass and capacity, with the unit of length, and as to standardization, assuming, of course, that the foot would be legally standardized. Standardization of the foot, therefore, is the only solution of the problem. The standard foot will comprehend the inch and every other decimal or common fraction of the foot and thus permanently establish the inch as a part of our system of mensuration.

I am not contending for an exclusive decimal system. I believe that we ought to recognize and employ decimal duodecimal and binate fractions of the foot as may best comport with the convenience of trade, fabrication and mechanics. It would be unnecessary and indeed undesirable to restrict ourselves to decimal fractions.

There ought to be the utmost liberty in the use of so-called common or vulgar fractions, every person to accommodate his own convenience in the matter of the division of the foot.

The duty is imposed upon Congress by the Constitution "to fix the standard of weights and measures." This duty ought not longer to be delayed. If we can get the standard foot and its corollary measures established by law, the problem will be finally settled, and an end would be made of the agitation to adopt the impossible and impractical metric system. Mere negation and opposition will not suffice. The problem of standardization, decimalization and corelation must be met and satisfied, and the way is plain in adopting the standard foot as the basis of our legal system of weights and measures.

With kind regards, I am,

Yours, very truly,

SAM'L RUSSELL.

DECEMBER 6, 1921.

THEODORE ALTENEDER & SONS,
1217 Spring Garden Street, Philadelphia, Pa.

DEAR SIRS: I inclose my check for $2 for which please send me two boxwood scales of the foot, 1000ths to 10 by 1000ths to 100; one a flat scale as shown in figure 1 and the other with opposite bevels as shown in figure 2.

I desire to determine which style I like the best, as I shall require a quantity of scales in this form, with the words "decimal scale of the foot" imprinted thereon.

Very truly, yours,

SAM'L RUSSELL.

NOVEMBER 8, 1921.

Hon. S. W. STRATTON,
Director Bureau of Standards, Washington, D. C.

DEAR MR. STRATTON: I desire to procure for demonstration before the Senate Committee on Manufactures three cylindrical measures:

(1) To have an inside diameter of 13.536 inches (one square foot) and an inside depth of 15 inches, to hold a bushel of 1¼ cubic feet.

(2) To have an inside diameter of 12 inches and an inside depth of 15.28 inches, to hold the volume of 1 cubic foot.

(3) To have an inside diameter of 6 inches and an inside depth of 7.64 inches to hold one-eighth of a cubic foot or a gallon of 125 British fluid ounces.

I desire to be advised as to whether these measures could be made up in the shop of the Bureau of Standards, and as to whether you would want a request from the chairman of the committee for the same.

Kindly let me know just what may be done.

Very truly, yours,

SAM'L RUSSELL.

OCTOBER 28, 1921.

Mr. A. M. TRAVERS,
Legislative Service Bureau,
The Merchants' Association of New York,
New York City, N. Y.

DEAR SIR: I am sending you herewith two copies of Senator King's bill, S. 2856, to establish a decimal system of weights and measures for the United States.

It is the purpose of the bill to make the cubic foot the measure for commodities sold by volume. That will give us a certain and comprehensible volumetric standard for fruits, vegetables, and other like commodities. The cubic foot is a little more than four-fifths of the present bushel and, of course, is in every wise superior to the liter as a convenient commodity measure. The cubic foot of water is precisely 1,000 of our present fluid ounces and precisely 1,000 avoirdupois ounces in weight. There is, therefore, the same relation between the ounce and the cubic foot as between the cubic centimeter, or gram, and the liter. It was this fact which gave James Watt his original conception of a decimalized system of weights and measures, with all measures and weights derived from the single linear standard, the foot.

It has ben widely, but falsely, claimed that James Watt was the inventor if the metric system. This is not true. The inclosed bill comprehends precisely the original decimal system of James Watt. The standard foot is divided decimally into 1,000 points; and the standard ounce is divided decimally into 1,000 mills, thus doing away with grain weights in connection with the avoirdupois ounce. Four hundred and thirty-seven and one-half grains equal an ounce avoirdupois, which need only to be stated to demonstrate that the grain is an utterly impracticable fraction of the ounce.

The bushel weight is defined as 1,000 ounces, which is equal to 62½ pounds—the weight of a sound bushel of wheat. This arrangement, which is based on existing units in our common system of measures, will give us all the advantages of decimalization afforded by the metric system, will accommodate itself perfectly to decimal computations, and is otherwise 100 times more practical in the magnitudes of the units than is the metric system. It need only to be defined by an act of Congress to go into use immediately.

Congress defined the metric weights and measures in 1866. It is claimed by metric propagandists that a person can gain a knowledge of the metric system in 15 minutes. We have taken 55 years to find out that the country does not want the metric system and will not have it. It is perfectly a fatuitous thing to attempt to force the commerce of a great country like the United States into a metric strait-jacket. It is like attempting to use a child's toy wagon as a truck to carry freight; it simply can not be done.

English law, English language, and English measures, the common heritage of our people, exist without the force of any statute; and they cannot be abolished by arbitrary legislation. We have already had too many continental isms imported into the country. The initiative and referendum, bolshevism, socialism, and metricism are among them.

It would be a great deal more sensible to forbid the use of the metric system in the United States than to propose to abolish our common measures by arbitrary law. There is no room in the country for two systems.

Yours truly,

SAM'L RUSSELL.

SEPTEMBER 27, 1920.

J. R. BENTON,
Dean, College of Engineering,
University of Florida, Gainesville, Fla.

DEAR SIR: * * * I take the view that we should have an American decimal system of weights and measures. Our engineers have long since decimalized the foot for their purposes, and one may purchase from manufacturers of engineering tapes, tapes, and rules graduated in feet and tenths and hundredths of the foot. The mechanics have decimalized the inch for their purposes, and the mechanical trades are almost unanimously set against the introduction of the metric system. In short, they will have none of it; and this is true of both the British and American mechanics and mechanical interests. The commercial, industrial, and mechanical activities and interests, which are based

upon our customary units of measure and weight, including as they do those of North America, the British Isles, and the British colonies, not to speak of Russia, China, and Japan, so far transcend in volume and importance those of the Latin continental countries and Latin America that it is altogether unwarranted to speak of the metric system as an international system. There are no countries in Latin America which are equal in commerce to a number of our American States.

Neither Brazil nor the Argentine can be compared with States like New York or Pennsylvania, and the other Latin American countries rank far below the average of our American States in population and commerce. Moreover, the Latin American countries have a preponderance of native population which has little or no development in culture and the arts, and whose customs or desires are not to be considered in comparison with those of our country and the British Empire.

The metric system was defined by a Federal statute and legalized for use in the United States in 1866; and in more than 50 years intervening since that time has made no progress except in the laboratories. At the same time, the Latin American countries, like a flock of sheep, went over to the metric system. It was just a fad and experiment and even though legally established, it has had but a scrambling use, sharing the field with the old Spanish and with the English units and measures.

While the metric system is scientifically arranged, the units of the system itself are inconvenient and impracticable, except in the laboratory. The point I tried to make in the statement before the congressional committee was that the foot constitutes a more practical and convenient base for a complete decimal system than does the meter. We have all eternity before us, and should therefore adopt a practical and convenient decimal system of measures for permanent use rather than the metric system, which after 50 years of legal definition and establishment has made no progress in the commercial and mechanical trades. The fact is that the metric system is not a decimal system.

There is no multiple as simple as ten used in the whole system. The primary division of the meter in a practical sense is not into tenths, but into centimeters or hundredths, so that the metric system is primarily a centissimal system. The real decimal system is based upon the division of the foot into tenths or decimal inches and into lines and points. This is the original system of James Watt, who is acknowledged to be the author of the idea of a decimal system of weights and measures. It is also a part of Jefferson's original plan for an American standard system of weights and measures. We adopted Jefferson's plan for the coinage. We should now complete Jefferson's project by adopting his system of weights and measures to coordinate with the decimal system of the coinage.

As far as the metric system is concerned, it is proposed in the bill to arbitrarily define the centimeter for American uses as one-third of the decimal inch, thus preserving the centimeter, the cubic centimeter, and the gram for laboratory uses and bringing these measures into aliquot relation with the new decimal system. This would give an ounce of 27 grams, or rather make the gram one-twenty-seventh of the ounce, so that the cubic centimeter and the gram would sustain the same relation to the cubic decimal inch which the cubic foot sustains to the cubic yard. That is to say, the cubic centimeter would be the cube of the third of the decimal inch. The third of the decimal inch only exceeds by ten sixty-three ten thousands of an inch the French centimeter, and as La Place and the French metricists missed the true lengths of quadrant by nearly a mile, the new American centimeter, defined as a third of the decimal inch, will be a nearer approximation to the theoretical centimeter than the present centimeter. Metric propagandists are proposing a world "ounce of 30 grams. The pending bill proposes to dispose of the whole metric controversy by defining the gram as one-twenty-seventh of the ounce and making our present ounce 27 grams for the accommodation of those who desire to use the gram and cubic centimeter in the laboratories or otherwise. The alteration of the centimeter and gram is so slight as to not be material for practical application and affords the tremendous advantage of an exact conversion into our common units.

I trust these observations will be worthy of your interest and consideration.

Yours, very truly,

SAM'L RUSSELL.

AMERICAN INSTITUTE OF WEIGHTS AND MEASURES,
New York, December 17, 1921.

Mr. SAMUEL RUSSELL,
342 Senate Office Building, Washington, D. C.

DEAR MR. RUSSELL: As promised you in Washington, I am inclosing to you herewith two copies of an article which originally appeared in the London edition of the American Machinist and was then reprinted in the New York edition of the same publication.

This article deals with the fact that according to our present law the American and British inch are identical.

Yours, very truly,

C. C. STUTZ, *Secretary.*

THE BRITISH AND THE AMERICAN INCH IDENTICAL.[1]

A REPLY TO A STATEMENT TO THE CONTRARY APPEARING IN THE EUROPEAN EDITION OF THE AMERICAN MACHINIST.

By C. C. Stutz, secretary American Institute of Weights and Measures.

Our attention has been called to some statements contained in an article written by Sir J. E. Petavel, director of the National Physical Laboratory, which recently appeared in your publication (issue of Jan. 8, 1921).

These statements are evidently based on widely circulated reports, which nevertheless are contrary to the facts. Our object in sending you this communication is to correct these erroneous impressions and thereby avoid wrong deductions.

Sir J. E. Petavel says: "In America the international meter is accepted as the primary standard of length, and the yard is defined by the relation, 39.37 inches equal 1 meter, an American inch of course being taken as one thirty-sixth part of this American yard. Now, the relation between the imperial standard yard and the international meter is 39.370113 inches equal 1 meter. Consequently the United States of America inch is longer than the inch as used in Great Britain by nearly three-millionths of an inch."

This is a great mistake. There is no difference between the inch in the United States and the inch in Great Britain.

The United States law of 1866 defines the meter in terms of the inch, the equivalent being 39.37 inches. This inch is the inch of England, which is thus made the fundamental standard of the United States by statute law, as it has been under common law since the first English settlement in 1607.

STANDARDS OF WEIGHTS AND MEASURES FIXED BY CONGRESS.

To make this perfectly clear we shall quote the law on this subject. To begin with we find the following passage in the Constitution of the United States: "The Congress shall have power to * * * fix the standard of weights and measures."

We quote the metric law as enacted by Congress July 28, 1866. (From Federal Statutes annotated, vol. 9, p. 1401.)

(11) Standard weights and measures.

SEC. 3569. (Use of the metric system authorized.) It shall be lawful throughout the United States of America to employ the weights and measures of the metric system, and no contract or dealing or pleading in any court shall be deemed invalid or liable to objection because the weights and measures expressed or referred to therein are weights and measures of the metric system.

SEC. 3570. (Authorized tables of weights and measures.) The tables in the schedule hereto annexed shall be recognized in the construction of contracts and in all legal proceedings as establishing in terms of the weights and measures now in use in the United States the equivalents of the weights and measures expressed therein in terms of the metric system, and the tables may be lawfully used for computing, determining, and expressing in customary weights and measures the weights and measures of the metric system.

---

[1] From a letter to the editor, European edition, American Machinist.

Measures of length.

Metric denominations and values:	Inches.
Meter	39.37
Centimeter, 1/100 meter	0.3937
Centimeter, 1/100 meter	0.3937

To bring out more fully the intent of section 3570 we requote it in the following abbreviated form:

"The tables * * * shall be recognized * * * as establishing in terms of the weights and measures now in use in the United States the equivalents of the weights and measures expressed therein in terms of the metric system."

Here the "inch" is taken as fundamental, the meter being expressed in terms of the inch. Clearly the object of this law was not to change our basic units but to make the use of the metric system permissible. This is further evidenced by the title of section 3569, which reads: "Use of the metric system authorizes," and by the expression in the section reading: "It shall be lawful throughout the United States of America to employ the weights and measures of the metric system."

The difference to which Sir J. E. Petavel refers is merely a difference between the bars used for comparison and results from the Mendenhall order of 1893 by which the reciprocal 3600/3937 of the legal expression 3937/3600 was ordered for comparing United States standards (39.37 inches equal 1 meter and 36 inches equal 1 yard).

This order is quoted on page 60 of circular No. 47 of the Bureau of Standards, Washington, D. C., under the title: "The Metric Standards Adopted as Fundamental," and reads as far as given there:

"The office of weights and measures * * * will in the future regard the international prototype meter and kilogram as fundamental standards, in accordance with the act of July 28, 1866." (Order approved by the Secretary of the Treasury April 5, 1893.)

This quotation undoubtedly gives the impression that the meter is for use in America the fundamental unit, unless one gives heed to the qualifying expression "in accordance with the act of July 28, 1866."

This act of 1866 should have been quoted in full. The title given: "The metric standards adopted as fundamental" is therefore incorrect. This order had no effect whatever on the legal length of the inch and yard. As pointed out previously, standards of weights and measures can not be changed in the slightest degree except by act of Congress.

The United States Bureau of Weights and Measures in 1893, and its successor the Bureau of Standards, could legally conform to the Mendenhall order only so far as the bar used for comparison was concerned. Under the law and the Constitution the sworn duty of the officials of those bureaus was and is to treat any variation between standards resulting from the use of the reciprocal (3600/3937) of the legal meter as merely a variation between bars used for comparison, just as the difference between the London yard and Sevres meter or between the different meter bars are taken into account in verifying standards.

Two facts should always be kept in mind.

(1) The United States yard and the British yard are exactly the same, and can be made to vary only by act of the British Parliament or by act of the Congress of the United States.

(2) The act of 1866 defining the meter as 39.37 inches established a United States standard meter differing slightly from the standard meter accepted by the International Bureau of Weights and Measures at Sevres.

The equivalent of the international meter is taken as 39.370113 inches in England, and as 39.370000 inches in United States of America; therefore the United States meter is shorter than the international meter, and the difference is expressed by $39370000/39370113 = .99999712902 + .00000287098 = 1.00000000000$, or approximately 287/100,000 millimeter, or nearly 3/1,000 millimeter.

This question can not be settled by asserting that the differences are negligible for ordinary measurements, and are material only when the highest degree of precision is involved. The principle is as important in one case as in the other. If it is conceded that an order of a bureau official at Washington can change the United States standard of the yard to any extent whatever, no matter how slight, then the same official can change this standard or any other standard by a larger amount.

Attempts have been made in the United States through the introduction of bills in Congress to secure the acceptance of the meter as the sole United States standard by the authority of Congress, but these attempts so far have failed, An incident of this kind is recalled by the Ashbrook-Stratton-Thurman bill of 1907, framed by the United States Department of Commerce. This bill was not passed, nor have similar bills found favor.

The temperature at which a bar is declared standard is naturally of great importance. The international prototype meter is standard at 0° C. (32° F.). The imperial standard yard is standard at 62° F. There is no legal statement in the United States as to the temperature at which a yard is standard. Such a legal statement is unnecessary until a legal physical standard of length is adopted. This we do not have. No physical standard of length has ever been established by Congress. Thus, legally, we must go back to the British imperial yard at 62° F.

It is for this reason that bars on measuring machines are generally made standard at 62° F. in the United States. According to the act of 1866 both the "inch" bars and metric bars must be made standard at the same temperature, in order that the relation between English and metric measurements made on such machines under similar conditions be in accordance with that act.

SIR J. E. PETAVEL'S REPLY.

TO THE EDITOR.

DEAR SIR: I have received proof of an article by Mr. C. C. Stutz, entitled "The British and American Inch Identical." I have been very interested to see this and to note the facts set forth.

I admit that we were certainly in some perplexity as to the exact position in the United States, but our conclusion was based on the statement of the Bureau of Standards circular No. 47, quoted in this article, which statement taken by itself would appear to show clearly that the meter and not the yard was accepted in America as the fundamental standard; and we believe it is a fact that the Bureau of Standards so interprets the Mendenhall order. None the less, it certainly appears from the article that this interpretation has not legal sanction, and that therefore it is the American meter and not the American inch which, in accordance with the law of 1866, must be regarded as slightly different from true standard.

Yours, faithfully,

J. E. PETAVEL, *Director.*

Teddington.

DECEMBER 20, 1921.

Mr. C. C. STUTZ,
Secretary American Institute of Weights and Measures,
New York City.

DEAR MR. STUTZ: I have your letter of December 19.

* * * * * * *

One question that occurs to me is whether or not a new standard American foot, derived from the yard in the National Physical Laboratory at London—and not being referred officially to the meter—could be made our prototype foot, and particularly whether or not it could be said that this prototype foot was in anywise less suitable as the base of our American weights and measures than is the London or Teddington yard for the English measures. Of course, the London yard and the Washington foot would be in perfect correlation. Could the foot in any sense be regarded as too short a linear unit for the prototype?

I have already spoken to you about the magnitude of the ounce and of its correlated fluid ounce or decimal cube as being suitable mass and volume units for use in chemistry, assuming, of course, that these units would be standardized and made internationally as definite as grams and cubic centimeters. Is there anything in the volume of the cubic centimeter or in the weight of the gram which makes them serve a purpose in chemistry which can not be equally served by the ounce and fluid ounce or decimal cube?

* * * * * * *

Very truly, yours,

SAM'L RUSSELL.

(Thereupon, at 11.30 o'clock a. m., the subcommittee adjourned subject to the call of the chairman.)

THE METRIC SYSTEM.

FRIDAY, DECEMBER 23, 1921.

UNITED STATES SENATE,
SUBCOMMITTEE OF THE COMMITTEE ON MANUFACTURES,
Washington, D. C.

The subcommittee met, pursuant to notice, in the committee room, Capitol, at 10.30 o'clock a. m., Senator Charles L. McNary (chairman) presiding.

STATEMENT OF MR. JUSTIN W. McEACHREN, REPRESENTING CRANE CO., OF CHICAGO, ILL.

The CHAIRMAN. Kindly state your name, residence, and occupation.

Mr. McEACHREN. Justin W. McEachren; residence, Portland, Oreg., editor of The Valve World, a magazine published by Crane Co., of Chicago.

The CHAIRMAN. Where does this magazine circulate?

Mr. McEACHREN. Generally throughout the United States and Canada, and practically wherever our field reaches throughout the world. We distribute many of them throughout Canada, England, France, Australasia, and South Africa.

The CHAIRMAN. Is the magazine published in Chicago?

Mr. McEACHREN. It is published in Chicago, and in view of the widespread organization we have it gives the editor the privilege of selecting his place to live, and that is how I happen to be so far away from headquarters. Shall I go ahead and present what I have to say?

The CHAIRMAN. Yes. Have you a brief to submit?

Mr. McEACHREN. No. I have just some notes here as a guide. I can make the statement short or long, but would prefer to make it short, if by so doing I can get in what I have to say.

The CHAIRMAN. Very good.

Mr. McEACHREN. I would like to state for the purposes of this hearing that I am formally representing the president of Crane Co., and also from the personal point of view I feel that I am representing just the average American citizen. That is the point of view from which I want to talk. But I am here solely at the instance of Crane Co. While working with other organizations along this same line I am not here as a representative of anybody but Crane Co. My expressions here will be the views of the company or of myself personally.

I believe I should now give my qualifications for appearing at this hearing.

The CHAIRMAN. It is not necessary. Let us get to the real controversy. Your reputation is well known, and the record shows your position.

Mr. McEACHREN. I feel that for the benefit of some members of the committee who quite excusably might not know what Crane Co. manufactures, I would like, if agreeable to you, to have that appear in the record.

The CHAIRMAN. All right.

Mr. McEACHREN. I will tell you in a few words what we do, who we are, and what position we take as manufacturers and as merchants who have studied this question.

Crane Co. manufactures valves and fittings, and the necessary equipment for all kinds of piping. We also manufacture certain lines of plumbing goods, but the point I want to bring out is that all our manufactures are of definite sizes. There is no change in our products after they leave the factory until they come into the hands of the user. So that we are in a position where we must pay

particular attention to the demands of the person who will ultimately use our products.

We do not manufacture in bulk so that a wholesaler or broker might break up what we sell and fix it in some other place to suit the demands of the buyer. We have to think of that right on through.

We have manufacturing plants at Chicago, Bridgeport, Trenton, Chattanooga, Birmingham, Montreal in Canada, Ipswich in England; and on our merchandising side we distribute our products through some 65 branch houses in the United States and Canada, and about 50 resident representatives in the United States, Canada, Great Britain, France, and Australasia. We are incorporated in the United States as Crane Co., in Canada as Crane (Ltd.), in England as Crane-Bennett (Ltd.), and in France as Compagnie Crane.

The purpose of that is to show that through this widespread organization we have made a study of the trade field, both domestic and foreign, and we are here as supporters of this measure as the result of this investigation we have made.

I would also like to stress the point that Crane Co. primarily does not appear at this hearing as a manufacturer but as a merchant. We have read the bill and see that the manufacturer is exempt from its provisions entirely as a manufacturer, and we do not feel that we have the right to express the manufacturer's view on it, but only the merchant's view.

But as others have appeared here as manufacturers, and have made it appear that the manufacturer is likely to suffer greatly in the matter of cost through the action of this measure, I wish to read a statement that was made to me by the president of the Crane Co.

The CHAIRMAN. Can you submit that for the record?

Mr. MCEACHREN. It is not in shape to hand to the reporter, so I will have to read it, but it is very short.

The CHAIRMAN. Very well.

Mr. MCEACHREN (reading). "In view of the distinct benefits which we are confident would follow the exclusive use of the international decimal metric system, both in our domestic and foreign trade, to the extent provided for in Senate bill 2267, we do not believe the expense involved in such a change would be great, but even if it should be proposed to make the international decimal metric system the sole system of weights and measures for the United States and for the world, in industry as well as in commerce, and the expense of such a change should be considerable, Crane Co. is quite willing and ready to make the change in company with the other manufacturers of the United States."

That states our position on both the metric system and this present bill.

Regarding the bill itself, which I feel is all I have come here to talk about, and to do what I can to forward its interests, as it stands is acceptable to Crane Co. But I desire to make this suggestion personally, and Crane Co. will agree with me in it, that I should like to see the bill more clearly defined, and particularly in its title—for instance, that the title read something like this:

"To fix the meter, liter, and gram as the single standards of denomination, volume, and weight for all purposes of barter and sale of movable products and commodities."

I think with that title it would more nearly accomplish what we think should be done.

The CHAIRMAN. Why is it necessary to include all that verbiage? What is wrong with the present title?

Mr. MCEACHREN. It allows those who feel that we are going to bring in the whole metric system to come in here and object. I believe that on account of it not being clearly defined we have had a good deal of opposition.

The CHAIRMAN. The title to a bill is nothing but an index to its general purposes.

Mr. MCEACHREN. I know that.

The CHAIRMAN. I think this is a very simple title, much more simple than that you have suggested, and meets the requirements of the statute.

Mr. MCEACHREN. Then bring that out somewhere else in the bill itself.

The CHAIRMAN. Does not the bill state its purpose?

Mr. MCEACHREN. The bill does not aim to bring in the entire metric system now in all its possible uses and for every purpose in the country. For that reason we have so much opposition to the present move, Senator. Take the testimony of the Army and Navy here—which to my way of thinking, the bill does not affect at all; yet they have presented very strong appearing testimony

against this measure. I think they were speaking more as to the general use of the metric system.

The CHAIRMAN. I think they were speaking of the general system and its enforced application.

Mr. McEACHREN. I think perhaps they got that impression from the bill.

The CHAIRMAN. I am glad to have your suggestion, and it will be considered by the committee.

Mr. McEACHREN. It is my opinion that there would be less objection to the bill if its purposes were more clearly defined, because I look upon this measure more as an educational proposition than anything else, and I would like to see that part of it favored. For that reason I would like to make this suggestion, that in section 6, where the Secretary of Commerce is directed to take certain action, there be included a clause that within not more than a year after the passage and approval of this bill, the Secretary of Commerce take such steps as might be deemed proper and lawful to get the school authorities of the different States to adopt uniform education for the metric system, so that it would be taught uniformly in our public schools.

The CHAIRMAN. You mean that he would, through propaganda, attempt to bring that about?

Mr. McEACHREN. Yes. I do not believe he could do it properly in any other way, such as through suggestion, and so on, to the school authorities of the various States.

The CHAIRMAN. I think that is a good idea.

Mr. McEACHREN. Now may I say this, that I am looking at this and I believe this question should most properly be studied from the wide international point of view rather than from a national point of view; and also keeping this clearly in mind, that we are aiming to take steps to affect conditions 10 years hence—not now. We might be too much disposed to look at present conditions and permit that view to a certain extent to bias our judgment in considering this bill.

I have come here with that thought in mind, that it is more of an international proposition than anything else; that it is for 10 years from now (things move very rapidly in these days, you know); and that we should attempt to see as well as we can, as near as we can, what conditions are likely to be 10 years from now, judging from the present trend.

Referring to the matter of compulsion, that really never enters my head, because when I became an American citizen I felt I was agreeing to abide by the rule and will of the majority, and when that will was once expressed, having agreed beforehand to abide by it, it could not be called compulsion. In the same way I am looking at other things along that line which deny me, personally, much more than this bill, that I am not compelled to do what I have previously agreed to do. Looking at it from that angle, I do not take any very serious view of the compulsion feature of the bill, whatever it may be.

I know that in all such movements as this it is necessary to set a date after which this will be done, and, further, that the tendency now, as I see it, is great enough in that direction to set 10 years from now as a reasonable limit, because I believe that in 10 years there will be really very little opposition in this country—and in others—to the metric system, as the movement has been growing so fast in recent years.

The CHAIRMAN. If the movement has been so fast, why not let it proceed with its own momentum? If it has the merit, certainly it must have the weight to carry it over.

Mr. McEACHREN. We prefer to help it along.

The CHAIRMAN. I do not recall any evidence before the committee of the development in this country of a great demand for it.

Mr. McEACHREN. I have been studying this subject for 10 years and you would be surprised at the advancement I have noticed in that time.

The CHAIRMAN. We have had witnesses before the committee who have testified that it is inferior even to the present system.

Mr. McEACHREN. I have not the slightest doubt you can get all sorts of views on any subject.

The CHAIRMAN. You know I have heard both sides of the controversy up to date. You are radically in favor of the metric system——

Mr. McEACHREN. Pardon me, Senator; not radically.

The CHAIRMAN. Strongly, then.

Mr. McEACHREN. Strongly or, rather, conservatively in favor of it.

The CHAIRMAN. I will have to form my own estimate of that from your testimony, and of course you are entitled to your view. As to the element of compulsion, you say there is nothing in that. I think that is the most essential or important element in the whole scheme, setting arbitrarily a certain period of time, telling the American people they will have to change about on this subject, face about on a matter that is in everyday use. That does not coincide with the temper of the American people as I have seen it manifested. That element, to my mind, is one of the most serious things in the bill, but you say there is nothing to it at all.

Mr. MCEACHREN. Oh, not at all. I do not say there is nothing to it. Perhaps there is a great deal to it. But I say there is nothing to it in comparison with the broader view, which is the international view. We are getting ready for a world condition; not a local condition.

The CHAIRMAN. How much business have you lost in the past from the lack of the metric system?

Mr. MCEACHREN. It would be difficult to say in dollars and cents, but we have had cases where we could have sold much more, and could have sold more rapidly, if we had been able to sell or been able to talk in the language of the customer. It is a basic principle of salesmanship that the buyer must be served; you must meet his views and his habits, even his caprices. And the nations that have made such study of foreign markets have been the nations that have sold most in those markets, and we will have to come to that. We do not question that for a minute. Crane Co. have made a long and careful study of that field and have come to that conclusion very deliberately.

The CHAIRMAN. I understand that is your view. Why is it that other big concerns, like the Baldwin Locomotive Works, can use both systems with perfect accuracy without any hardships or additional cost and meet all conditions?

Mr. MCEACHREN. Certainly.

The CHAIRMAN. Why can you not do that?

Mr. MCEACHREN. We could.

The CHAIRMAN. Why do you not?

Mr. MCEACHREN. But everybody in foreign countries does not buy a locomotive.

The CHAIRMAN. If you can do it with a locomotive, why can not you do it with a baseball or a sewing machine?

Mr. MCEACHREN. You can with a baseball or a sewing machine, but not with pipe fittings.

The CHAIRMAN. I believe in the system, as far as that goes, but the question with me is how are we going to fasten it on the public. I am inclined to believe that it will not be by compulsory action in 10 years, in any event. If the present situation is impeding our foreign commerce I think the law of commerce and economics would apply to bring about a voluntary renovation of the thing. Using the analogy of a tool, when I find the tool I am using is not as effective or as efficient as another, I discard it and take up the new one. I do not need legislation to compel me to do it.

Mr. MCEACHREN. Yes.

The CHAIRMAN. If the commercial interests of our country are suffering, why do not the interests that may use this system take it up and adopt it among themselves, so that they may be able to expand their foreign trade as you say. But why force it on some one, or some class, who will derive from it no benefit at all—and that is the great mass of the people? No one has yet answered that to my satisfaction.

Mr. MCEACHREN. Suppose, Senator, that in the use of that one tool, to which you referred, there is nobody concerned but yourself—you handle it and you have it shaped to fit your hands and to suit your purposes.

The CHAIRMAN. Yes.

Mr. MCEACHREN. But if the use of that tool concerns several of your neighbors, I think you will find it would be necessary, to get efficient work out of that tool, to consult them and see if you can find some tool that would be commonly used.

The CHAIRMAN. Does that apply to the case? Let us see. You are manufacturing at plants in various parts of the country products that are going to foreign lands. What is your principal manufactured product?

Mr. MCEACHREN. There are about 20,000 different items; but in addition to our pipe-fitting lines we have plumbing goods.

The CHAIRMAN. I can see in that particular case where it would be of some value. You are a manufacturer and you adopt a system to meet foreign de-

mands where the metric is the established system of the country in which you sell your product. How does that system affect the man who is raising cotton in North Carolina or oranges in California? Is he benefited by reason of your people getting the metric system? Why not let him go and do as he pleases? If he wants to sell his land by the acre, his fruit by the pound, his cotton by some other measurement, why should he not be permitted to do that? Why should we say to him: "Here, you must change your whole plan, submit yourself to a new scheme of things; take these new tools and use them, whether you like them or not, and whether they do any good or not"?

Why go clear down through the whole country and make everybody adopt it, and bring about this enforced transition, with the annoyance that would follow changing the vehicles which we use to measure and weigh different articles, in order to simplify the methods or to increase the advantages of manufacturers?

Mr. McEachren. The manufacturers are not asking anything in this bill.

The Chairman. Or exporters?

Mr. McEachren. It is only merchants.

The Chairman. I have not heard of any large merchant selling abroad Now, that is the proposition that is bothering me. Where does it help the people I have mentioned?

Mr. McEachren. I can see your point of view and sympathize with it. I wish I could get you to see mine.

The Chairman. I see your proposition.

Mr. McEachren. We are looking at this proposition not as it affects one or two here and there, or this class or that class, but as it affects all.

The Chairman. How is it going to affect the orange grower, the lumberman, or those who raise wheat, corn, or cotton?

Mr. McEachren. Take this one point: It has been shown here and has not been disproved—and I think it can not be—that the use of the metric system does result in the saving of time. If we can throughout this whole country——

The Chairman. We had various testimony on that point. I think it was Mr. Haynes, the automobile man, who said that it would save a child two years in school. That seems to me to be absurd.

Mr. McEachren. We know from our own practical experience that it does save time. If we save time in industry generally we are going to save money.

The Chairman. How does that affect the orange man?

Mr. McEachren. It will eventually reduce all costs.

The Chairman. How?

Mr. McEachren. It must eventually.

The Chairman. How?

Mr. McEachren. All savings reach the point of cost.

(Informal discussion followed which the reporter was directed not to record.)

Mr. McEachren. May I speak now of why I think it would be very valuable to us to have a definite time set?

The Chairman. Surely.

Mr. McEachren. May I say a definite time set in an elastic way. I would be in favor of this limitation period of 10 years being put into effect by proclamation, by consent of the Senate, something like the plan that has been adopted by Japan, so that we can say to the pupils in the schools: "At a certain time before you have gone beyond the period when you begin to profit by what you have learned in school, you are going to have an opportunity to put this metric system into effect; you are going to be using it in your daily life."

Judging by an examination of the figures of school attendance, at the end of the 10-year period there would be conservatively 10,000,000 children using it in the public schools, and using it practically. If there is no demand for it there will be no use for it and they will forget what they have been taught. It would be really lost time teaching them. But give them the promise that at a certain time they will be using it and it is necessary to learn the system now.

That is one of the strong reasons for it. I want to say earnestly that if Crane Co. and myself personally were here only for Crane Co., we would not be here at all. If Crane Co. did not believe that there was a big, broad, general benefit to be gained from this, not only for the United States but for the world at large, we would not favor it. But we do favor it now, because we see that it is inevitably coming. It has been coming step by step right along.

During the period of our business, covering 60 years, and covering a period of 20 years in which we have made an active study of the question, we have seen the time coming. I could cite, if I may, a single instance, which would sh the effect of its gradual growth.

The CHAIRMAN. Let us have it. That is what we want.

Mr. McEACHREN. To-day industry, business, and individuals are not content to just let things drift. They want to help along what they think is worth helping. If it is good, let us have it quickly. If it is beneficial where it has come into effect—and we believe it would be beneficial here—why wait a generation or two, but let us further it all we can and give greater benefit not only to ourselves but to those that follow us.

In other words, we are working for the future. We want to use it everywhere, because of the great mass of people in foreign lands that are now using it, legally anyway, or who have nothing else to use; because of the immense amount of surplus products we are going to have in this country. We believe we could do business better and do more of it. I believe we could bring the people of the United States in contact with other peoples of the world easier.

In other words, it would be the first step toward a universal language. If we could make the three basic words of the metric system universal we would have taken a big step toward a common tongue, for trade anyway, and it would not be long perhaps before we would have an international currency.

Senator, I really am in position better to answer questions from what you have said.

The CHAIRMAN. Are those notes you have before you?

Mr. McEACHREN. Yes; notes and extract; but simply to guide me in what I might have to say.

The CHAIRMAN. I thought perhaps they might be in the form of a brief. Are they printable?

Mr. McEACHREN. No. May I add this while I think of it: In view of the fact that the point has been raised here of the great cost to the manufacturer and confusion to the mechanic, I would like to give just the practical side of it, as Crane Co. have experienced it, as an example which will be found to be valuable.

In our Chicago shops Crane Co. employ in the neighborhood of 7,000 men. Out of that number there are not more than 300, probably less, fewer than that, who in any way handle tools of precision or who would have to be concerned with whatever system of measurement we used in our manufacturing. These few selected, trained, and skilled workmen make the tools, the gauges, templets, jigs, and so on. I am speaking of the trained mechanic. Now, the man who represents the larger mass, all he knows is that this is a "go" or a "no go" gauge. That is the common phrase. The man who is operating the machine knows only that about it. We can change the gauge as often as we like. All he has to do is to see that it goes on or does not go on.

That simple statement covers the whole ground as to the confusion that might result in the shops through the change in production operations by the introduction of the metric system, except in the few small instances where the product is tools of precision. That may be taken to be the fact, Senator, and I think it can not be refuted.

It may even be lessened in the proportion that as these shops of ours represent the average American industry to-day, where we are on the quantity basis, that the very great mass of workmen who turn out the products would really be affected in no way whatever. And as far as confusion is concerned, if there were any it would be restricted to a very small inner circle. They would know little about it themselves and the public would know nothing about it.

Personally I may say that in 1879, as an apprentice, I was brought a metric drawing to make a bit of machinery that had been made in Germany. At that time Germany had had the metric system in effect seven or eight years, and this was a piece of machinery brought to a small town in Canada where I was learning my trade to match a button machine for making buttons. The drawing was probably the size of that paper [indicating]; it does not matter. It was a little tracing. It was brought to me, and I was asked: "Do you know anything about a thing like that?" I said, "That looks like a metric drawing." "Could we use it?" "If we had a rule," I said.

The short and long of it was I went up to the button factory and borrowed a half-meter rule, brought it back to the shop, set my calipers on that rule, and made the little piece of machinery.

And that is all the confusion that is likely to happen. I could bring you man after man to testify to the same thing. During the year we used both systems interchangeably without difficulty. But when the problem did arise, when there was precision to use, we turned the job over to the expert room, and it was taken care of there.

I think that may be taken as a true statement of conditions that will be found throughout the factories of the United States.

When it comes to the cost of scrapping, there will be no such cost, because there will be no scrapping. Gradually the manufacturer in his replacements will change his gauges, and so on, and when sizes are changed they will be changed by international or national agreement, just as the present standards have come into effect.

But that does not concern the people generally and to a small extent concerns manufacturers. But Crane Co. wish to stand on the proposition that even if the cost were great we believe the benefits would be so much greater that we are ready to join with the rest in the general adoption of the system, now, to-morrow, next year, 10 years or 20 years hence. We are ready.

(Informal discussion ensued which the reporter was directed not to record.)

The CHAIRMAN. Then, as I understand it, you will submit a brief to be made a part of the record.

Mr. MCEACHREN. Yes, sir.

The CHAIRMAN. When will you have it ready?

Mr. MCEACHREN. I will submit it next week.

I believe that at this point I can best serve this committee and the interests I represent by submitting the remainder of what I had in mind to say as a brief, and, with the permission of the committee, I shall do so.

The CHAIRMAN. You have that permission.

(The brief follows:)

I do not think that any person looking at this question broadly and with an open mind would consider the following assumptions as unreasonable or unsupported by facts:

1. That it would be a good thing for the world—and therefore for the United States—if the trade of the world might be carried on in a universal language and in terms of measure and weight universally recognized, understood, and standardized.

2. That as only 2 nations of any considerable importance have not yet adopted the international decimal metric system as their sole system of weights and measures, and that 39 nations have adopted that system as their sole legal system of weights and measures, it is more likely that the international decimal metric system eventually will become the one universally recognized and used standard, than that the system now used more commonly by the 2 nations referred to will reverse the processes of evolution and become the one universally recognized system of weighing and measuring.

3. That the international decimal metric system is simpler, more scientific, more coherent, more readily learned and understood, and more adaptable to complete international use than is the so-called English system now in more general use in the United States and Great Britain.

4. That a decimal meter, liter, and gram, closely related to one another, are more desirable and useful companions for a decimal dollar than are its present vulgar associates—a 36-inch yard, a 32-ounce quart, and a 16-ounce pound, no one of which bears any clear and definite relationship to either of the others, or to the dollar.

With the acceptance of such general assumptions and from the international rather than the national—from the general rather than from the sectional—point of view only is it fair and just to consider the merits of this bill.

It should not be handicapped on the one hand by claims of advantages, etc., for the metric system that go beyond the bounds of the bill, or on the other hand by attacks from quarters not in any way to be affected by its provisions.

This bill is strictly and simply a selling proposition. It does not in any way directly affect manufacturing or production; it does not directly affect buying. It affects only the seller. Only the seller would be required to abide by its provisions.

Thus it aims to protect the manufacturer in all his productive processes from any disturbance or loss which he may believe might follow the adoption of the metric system in this country, if he also should have to use it in manufacturing; and it leaves the buyer to continue buying as he has been accustomed to and coming gradually and almost imperceptibly into the habit of using the metric system through educational contact with the seller.

It is unfortunate that this bill might not be considered by all sides strictly on its merits and according to its provisions, for while I have not had an opportunity of considering the arguments that may be advanced against it, I am so well acquainted with the character of the organized opposition, know

so well that it is composed almost wholly of manufacturing interests, that I have no doubt the vast bulk of those arguments will be based upon the views and fears of certain manufacturers rather than on the views of merchants—that is, the manufacturer is not likely to come here as a merchant but as a producer, and his objections to the bill will be based upon the great cost of the change to him as a manufacturer rather than on the probable cost to him as a merchant. I make this statement from a rather intimate acquaintance with what thus far has been offered in this country as objections to the more general use of the metric system.

This bill looks to probable conditions 10 years hence, not to conditions as they are to-day. It is in the nature of an educational or preparatory measure, a paving of the way for the commerce of the United States after present unusual and abnormal conditions in both domestic and foreign trade have changed to normal. It recognizes as a fact that the international metric system is growing in favor throughout the world, and that United States exporters undoubtedly will be handicapped in the competing with the exporters of other lands unless they—our own exporters—are prepared to serve the foreign buyer in the way he wishes to be served. Other countries even now are doing this, because they have prepared to do it. The winning countries in international trade will be those countries that recognizes as a basic principle of all trade that the buyer must be served—served not alone in his reasonable demands but served even in his caprices. Countries to-day that, despite abnormal conditions, are gaining in foreign trade, are gaining, and will continue to gain, chiefly because they aim to serve and satsfy the buyer, and are prepared through previous study of the field to give such service.

The most promising field for our foreign trade now, and for many years to come, is Mexico, the Latin Republics to the south of us, Japan, and Russia. I might also name France as a large potential buyer of our surplus products, but France more properly should be considered as a competitor. In all the vast territory of these countries, with its unlimited trade possibilities and opportunities for us, the International Decimal Metric system is the single legalized—and largely understood—system of weights and measures. China is reported to be making extensive use of the metric system, and indications point to its early exclusive adoption in that country, which is soon to offer unlimited opportunities for foreign trade. Does one need to argue the point that a powerful advantage in trading with those countries will lie with the seller who brings his goods to them in the way that most fully will meet their wishes, comply with their custom and habits, and satisfy without perplexity their understanding in terms?

The two most powerful factors in the world's trade to-day are the international decimal meter and the United States decimal dollar. Why should not the United States make full use of both of them?

There is one bit of opposition that I properly may take notice of because it already is in this part of the record, and that is the reports presented by representatives of the Army and the Navy.

Those reports appear to have considerable value as opposed testimony, but even a casual study of them must show that they have no place in any part of the record of this hearing and should not be considered as a part of it to the detriment or otherwise of this bill.

They deal with the general subject of the metric system and not with the provisions of this bill. Measures not metric have been read into the objections of the Navy. Most of the changes opposed never were dreamed of, and never were contemplated by this bill.

Circular or angular measurements, longitude, knots, time, etc., are not subject to change in any way by this bill, as claimed in testimony by the navy.

The meter, the liter, and the gram, with their numerical prefixes are all that are contemplated by this bill; and are all that this bill seeks to make exclusive for weighing and measuring at the end of 10 years from the date of its passage and approval.

It is admitted, frankly, that no particular advantage lies in either system—the metric or the English—while both are in permissive use side by side. In such a case the manifest merits of the decimal metric system—merits acknowledged even by some of its enemies—are handicapped by custom and habit, by what we might term the psychology of long-established usage—no matter how cumbersome, confusing, and unsystematic that usage may have been.

But it is a strong point in favor of the metric system that it has advanced in face of such conditions, even in our own country.

It is to meet the demands of this age for greater clarity, for greater efficiency, for readier interchange between ourselves and between us and other peoples, that this bill is offered. It is to give us, and in time, all of the world one trade language, and in such an effort steadily continued, the law of the survival of the fittest will do all the real "forcing" that is done in giving us the one most adaptable system. As a citizen of this country I can but hope that we may be wise enough to act in such a way that the forcing will not come from the world at large and find us the last nation to recognize the inevitable trend of events; to be a follower where we might have been a leader.

It has been my observation during the 10 years in which I have given special time and study to this question that I could trace any designed opposition to the international decimal metric system to a certain organization, the name of which gives no indication of its purpose and which is supported practically exclusively by certain manufacturing interests. Therefore to whatever extent this organization may appear at this hearing it appears as representing manufactures, and thus, improperly.

Crane Co. began its campaign in favor of the widest practicable use of the metric system long before there was any organization in the United States either for it or against it, and without the suggestion of any organization, individual, or firm. We started it, to use a homely phrase, "on our own hook," and we have carried it on in the same fashion.

Being in a position to receive and to read about everything that is printed and distributed on this question, both pro and con, it is our deliberate judgment that interest in the general adoption of the metric system, to the exclusion of all other existing systems, has grown steadily and now is widespread, and that many individuals and organizations, and even industries, are working, as we are, independently and in their own way to secure the advantages of the general use of the metric system, not only for our own country but for all the countries of the world.

I have not been able anywhere to find any sign of retrogression. Where once the metric system has secured a foothold, it not only has held that advantage but has made progress. I believe, and Crane Co. believes, its ultimate general exclusive use to be inevitable.

Crane Co. wishes to be ready for it when it comes. Crane Co. would be ready for it if it arrived to-morrow.

I believe the United States would reap a distinct advantage in foreign trade by adopting some such measure as this bill before Great Britain goes on an exclusive decimal basis—decimal metric in weights and measures and decimal in currency. In my judgment, and from close contact with the situation there, Great Britain to-day is nearer to the general adoption of decimalization of weights and measures, according to the international metric system, than we are in this country.

The metric system has been steadily, slowly, but surely, and with not a single backward step, drawing a circle of three simple little words around the world. The circle is now complete save for the gap in which stands as a bar to progress, the United States and Great Britain.

While those three words are simple and little, they are big enough and strong enough to bear the burden of the commerce and industry of the world, no matter to what proportions they may go.

This bill is an effort to make the gap in the circle smaller, and we believe that if this committee can see its way clear to give it a favorable report, either as it now stands or as it may be amended by its friends, a long step will have been taken toward increasing the business efficiency of the United States, and toward bringing the whole world into closer relations of understanding and good will.

(Whereupon the subcommittee adjourned subject to the call of the chairman.)

Measures of length.

Metric denominations and values:	Inches.
Meter	39.37
Centimeter, 1/100 meter	0.3937
Centimeter, 1/100 meter	0.3937

To bring out more fully the intent of section 3570 we requote it in the following abbreviated form:

"The tables * * * shall be recognized * * * as establishing in terms of the weights and measures now in use in the United States the equivalents of the weights and measures expressed therein in terms of the metric system."

Here the "inch" is taken as fundamental, the meter being expressed in terms of the inch. Clearly the object of this law was not to change our basic units but to make the use of the metric system permissible. This is further evidenced by the title of section 3569, which reads: "Use of the metric system authorizes," and by the expression in the section reading: "It shall be lawful throughout the United States of America to employ the weights and measures of the metric system."

The difference to which Sir J. E. Petavel refers is merely a difference between the bars used for comparison and results from the Mendenhall order of 1893 by which the reciprocal 3600/3937 of the legal expression 3937/3600 was ordered for comparing United States standards (39.37 inches equal 1 meter and 36 inches equal 1 yard).

This order is quoted on page 60 of circular No. 47 of the Bureau of Standards, Washington, D. C., under the title: "The Metric Standards Adopted as Fundamental," and reads as far as given there:

"The office of weights and measures * * * will in the future regard the international prototype meter and kilogram as fundamental standards, in accordance with the act of July 28, 1866." (Order approved by the Secretary of the Treasury April 5, 1893.)

This quotation undoubtedly gives the impression that the meter is for use in America the fundamental unit, unless one gives heed to the qualifying expression "in accordance with the act of July 28, 1866."

This act of 1866 should have been quoted in full. The title given: "The metric standards adopted as fundamental" is therefore incorrect. This order had no effect whatever on the legal length of the inch and yard. As pointed out previously, standards of weights and measures can not be changed in the slightest degree except by act of Congress.

The United States Bureau of Weights and Measures in 1893, and its successor the Bureau of Standards, could legally conform to the Mendenhall order only so far as the bar used for comparison was concerned. Under the law and the Constitution the sworn duty of the officials of those bureaus was and is to treat any variation between standards resulting from the use of the reciprocal (3600/3937) of the legal meter as merely a variation between bars used for comparison, just as the difference between the London yard and Sevres meter or between the different meter bars are taken into account in verifying standards.

Two facts should always be kept in mind.

(1) The United States yard and the British yard are exactly the same, and can be made to vary only by act of the British Parliament or by act of the Congress of the United States.

(2) The act of 1866 defining the meter as 39.37 inches established a United States standard meter differing slightly from the standard meter accepted by the International Bureau of Weights and Measures at Sevres.

The equivalent of the international meter is taken as 39.370113 inches in England, and as 39.370000 inches in United States of America; therefore the United States meter is shorter than the international meter, and the difference is expressed by $39370000/39370113 = .99999712902 + .00000287098 = 1.00000000000$, or approximately 287/100,000 millimeter, or nearly 3/1,000 millimeter.

This question can not be settled by asserting that the differences are negligible for ordinary measurements, and are material only when the highest degree of precision is involved. The principle is as important in one case as in the other. If it is conceded that an order of a bureau official at Washington can change the United States standard of the yard to any extent whatever, no matter how slight, then the same official can change this standard or any other standard by a larger amount.

The CHAIRMAN. Mr. Richards, you have appeared before.

Mr. RICHARDS. Yes, sir. I have gone over the hearings, Senator, and on behalf of the American Metric Association I desire to submit this brief.

The CHAIRMAN. Very well; this may be made a part of the record.

(The brief referred to follows:)

Omitting the testimony of Mr. Henry D. Hubbard, Admiral R. E. Coontz, United States Navy, and Col. Tschappat, United States Army, who represented Government departments and who presented various views in regard to the metric system, the following is a summary of the testimony submitted, by pages:

Part 1, pages 3–50, avowed advocates of the metric system.

Part 2, pages 50–85, 117–168, avowed advocates of the metric system.

Part 3, pages 171–240, Mr. C. C. Stutz; pages 240–247, a group of men who happened to be in Washington on other business, brought in for a short time through the efforts of Mr. C. C. Stutz.

Pages 247–257, Mr. E. C. Peck. Mr. Peck has been associated with Mr. Sharpe in opposition to the metric system and presents a remarkable estimate of the cost to one company, giving the supposed cost of a change to the metric system. Yet this is the only attempt the opposition has made to prove their statements relative to the cost to certain manufacturers of making the change to the more convenient metric units. This extraordinary estimate has all the appearances involved in buying great quantities of new material, and contains such items as "extra salesmen, $10,000;" "interest, taxes, and insurance on $500,000, additional investment, $40,000;" "cost of unnecessary instruments calibrated in inches which can not be changed over, $19,000;" "spoiled work under most favorable conditions, $5,000 per month for first six months, half of this for next six months, $45,000."

And yet this is the nearest approach to any estimate presented by any company that was not apparently ashamed to give its name.

Pages 257–259, Mr. C. C. Stutz. The position of Mr. Stutz, who presented 48 per cent of the material in opposition to the metric system, should be clearly understood. The following items in connection with the position of Mr. Stutz were brought out before the committee on October 13 (p. 41), when Mr. Stutz was present. He is obliged to admit that Mr. Henry D. Sharpe, treasurer for a company that has a peculiar interest in opposing the metric system, had organized what opposition he could to the metric movement. He has, as treasurer for his company, also contributed $1,000 to the work of this opposition. For at least six years Mr. C. C. Stutz was employed by the company of which Mr. Sharpe is treasurer. Mr. Stutz, in accepting his position to fight the metric system, has sent out printed matter stating that the general use of the metric system will involve great expense to manufacturers and advising manufacturers to contribute to oppose the metric system. With the proceeds raised for salary and expenses. Mr. Stutz is naturally in honor bound to oppose the metric system.

It has been shown that Mr. Halsey and Mr. Dale, whose opinions are copiously quoted, have also been confessedly employed from time to time with the purpose clearly stated and brought out on page 41 of these hearings in the former's own words: "We have killed the metric system before and we will kill it again."

Mr. Sharpe and his employees have a perfect right to say whatever they care to say about the use of metric weights and measures. We hold, however, that it is unfair to present their unverified material in the name of others.

Pages 268–273, Mr. Samuel Russell. It should be noted that Mr. Russell, who presented all this testimony, is the author of the decimal bill which attempts to create practically a new system of weights and measures based on the decimal inch of 3 cubic meters and a decimal ounce equivalent to the weight of 27 cubic centimeters of water. Mr. Russell's testimony extends from page 268 to 273, and from page 301 to 320. Although there is interest in his advocacy of the introduction of a fourth ounce and a third pound, yet this testimony can not be taken seriously with reference to the opposition to the Britten-Ladd bill. In this connection we would add that we have as an exhibit two copies of a portion of one of Mr. Samuel Russell's testimony, which have been printed separately by the Government Printing Office under date of December 6, 1921, and franked out from Washington.

Mr. S. S. Dale, who also admits being employed by Mr. Henry D. Sharpe et al. to oppose the metric system, begins his testimony on page 273 and ends it on 294. Although Mr. Dale is not an engineer, he does not hesitate to take issue

with the leading authorities. Mr. Dale's testimony is remarkable in its misuse and misrepresentation in regard to what the metric system is and how it should be used. We challenge Mr. Dale and Mr. Stutz to indicate who follow the peculiar practice in the explanation they make in reference to the ratio between the United States inch and that used in England, or to point out one manufacturer who is to-day doing work requiring real accuracy who depends on any other fundamental standard than the international meter.

The material submitted from the report of the National Industrial Conference Board deserves comment. The board's committee consists of Mr. Henry D. Sharpe and two others associated with him in his attacks upon the metric system. The two other members of this committee, Maj. Fred J. Miller and Mr. Frank O. Wells, are members of the American Metric Association and ardent advocates of the metric system. No original research or estimates of cost were made by the National Industrial Conference Board.

The statement of Mr. C. C. Stutz on pages 183 and elsewhere, portending to show that "labors" would not be reduced, is clearly refuted by the following new evidence:

Mr. Edwin Lundgren, M. E., has submitted a working drawing of a steel plate designed for a girder. The linear dimensions, taken from the ends of the plate and hole centers, are as follows:

Ft.	in.	
	1 1/16	27
	2 1/8	54
	2 1/8	54
1	8 3/4	527
	2 1/4	57
3	1 1/8	943
	2 1/4	57
1	3 3/4	400
	2 1/8	54
	2 1/8	54
	1 1/16	27
7	4 3/4	2,254

It will be noted that 70 figures and symbols are required in the old method and 29 under the metric method. This effects a saving of 58 per cent. Not only is time saved in the preparation of such a drawing, but there is a corresponding saving whenever the drawing is used. While typewriting and printing are in vogue, such elimination of fractions and special symbols will be much appreciated.

We have, for another example, a working drawing presented by a prominent locomotive company in the United States. It is a side and top view of an ordinary gauge cock. The drawing is full size. The words "all dimensions in millimeters" obviate the need for the familiar abbreviation, m. m. after the figures in the drawing. There are 39 dimensions noted, and not one of these includes a fraction of any kind. If inches had been used in the design and manufacture of this particular American product, only 6 of the 39 dimensions could reasonably have been expressed in an integral number of inches.

That is, by doing the work in millimeters the inconvenience of 33 fractional numbers and the corresponding involved calculations were avoided. These two illustrations are typical of the saving effected in the measurement of length, area, volume, and in the more involved calculations. It may fairly be said that the more difficult the problem the greater is the advantage in having it worked out in the metric way.

The surprising intimation has been made that the adoption of the more convenient metric method of weighing and measuring involved the abandonment of the American railway gauge, certain pipe sizes, etc., but these can be and are expressed in millimeters quite as accurately as in any other measure. In this connection the testimony of two men who have found this true may suffice: Theodore H. Miller, works manager of the De Laval Separator Co., said, in his recent testimony in behalf of the Britten-Ladd bill: "About 1910 we changed to the general use of the metric system throughout our plant. The advantages gained by the use of so simple a system as the metric have been worth to us more than ten times the slight initial cost required to make the change."

Mr. Burgess Darrow, chief of the technical division of his company, is quoted: "We of the Goodyear Tire & Rubber Co. argued quite a lot about the metric

system until we finally adopted it. Now, as we look back on it, we wonder why we didn't adopt it long ago."

The international metric standards have been the fundamental standards of the United States since April 5, 1893. From that date our Government has never recognized the British standards, which are only national and differ somewhat from our own. It has been and is a distinct benefit to the United States to have its fundamental standards in common with every other nation, there being only one important exception. The British gallons, quarts, fluid ounces, minims, etc., differ by more than 20 per cent from the corresponding units of the United States. These common United States measures of capacity are illegal even in Canada, while the corresponding Canadian measures are illegal in the United States. Happily, however, the metric measures for length, capacity, and weight are now either legal or obligatory in every country on earth, and these are helping to bind together the English-speaking peoples.

In the report to the national council regarding the metric referendum reference is made to the metric system and British yarn "counts." In a book, Yarn Tables, printed by M'Lennan, Blair & Co., the well-known yarn merchants of Glasgow, their position is stated, as follows:

"The metric system of weights and measures is so perfect and has been adopted so widely that it forms the most suitable basis for a uniform system of counts of yarns.

"Several conferences have been held on this subject, the most recent being that of Paris, in 1900, where it was agreed that the best system was that of a fixed weight and a variable count length. The unit was fixed at 1 meter, equal to 1 gram. No. 1 would mean that a length of 1 meter would weigh 1 gram; No. 100 would be 100 meters per gram, etc."

In coming to the general use of metric measures American manufacturers and exporters are wisely paving the way for permanent world-wide markets. Our association was glad to assist in the preparation of the metric report of the National Industrial Conference Board, which gives the dates when the metric system became obligatory in 36 countries. Cuba, Panama, Ecuador, Peru, Bolivia, Greece, and other countries might also have been classed as metric in this report of 1921. The metric movement is advancing so rapidly, however, that since the report was issued Japan has passed legislation to make the metric measures the only legal measures in Japan. Russia made the metric system effective on January 1, 1922, with a two-year tolerance for certain old units, which must be discarded before 1924; and metric measures became obligatory in Lithuania on January 1, 1922. From all we can learn such legislation has been taken as the best method of securing the use of measures most satisfactory and advantageous to the people.

Metric legislation in the United States is needed to guard the interests of those who are in danger of being left alone in the use of the older weights and measures. We believe that from now on the change should be brought about by cooperation and through an act of Congress which will insure against confusion and minimize the comparatively small actual cost of making the change.

We believe that the opposition has entirely failed to break down the great mass of prometric evidence brought out in support of section 8 of the Britten-Ladd bill, which is as follows:

"SEC. 8. That nothing in this act shall be understood or construed as applying to—

"1. Any contract made before the date at which the provisions of this act take effect.

"2. The construction or use in the arts, manufacture, or industry of any specification or drawing, tool, machine, or other appliance or implement designed, constructed, or graduated in any desired system.

"3. Goods, wares, or merchandise intended for sale in any foreign country, but if such goods, wares, or merchandise are eventually sold for domestic use or consumption then this clause shall not exempt them from the application of any of the provisions of this act."

In this connection the chairman of the Senate subcommittee of the Committee on Manufactures and all other men whose opinion has been sought agreed that the Britten-Ladd bill in no wise prevents any or all citizens of the United States from ordering by name, goods, wares, or merchandise in terms of any weight and measure in which it may be manufactured. For instance, it is the opinion of these gentlemen, and our opinion, that the Britten-Ladd bill, when it becomes effective, will not inhibit anyone from ordering pipes,

taps, dies, etc., in other terms than in millimeters. We believe that as it should be and that American manufacturers should be encouraged y way possible.

CHAIRMAN. What additional verbal statement do you desire to make?
RICHARDS. In order to save time I would ask that you let us know as to nts about which you may be uncertain in regard to reporting out the bill.
CHAIRMAN. Do you expect it to be reported out in its present form?
RICHARDS. I certainly believe it should be, in view of all the evidence s been brought out. We are ready to consider any modifications, but there is some far more important objection than has been suggested so are sincerely of the opinion that the bill is a good bill. I would ask any concrete points that impress you with regard to the opposition.
CHAIRMAN. Of course, I can not say what the attitude of the committee I have certain definite notions.
RICHARDS. That is just what we want to hear.
CHAIRMAN. I am not prepared, perhaps, to state them to you—not for ord at least.
reupon informal discussion followed, which the reporter was directed ecord.)

IONAL STATEMENT OF MR. THEODORE H. MILLER, REPRESENTING THE DE LAVAL SEPARATOR CO.

MILLER. I have followed with a great deal of interest the testimony this committee and before other organizations on the bill, and my at- has particularly been called to an article in the American Machinist uary 23, entitled "Side lights on the discussion of the metric system national council meeting," where it was stated that the metric system ocated, so far as the testator knew, by only one manufacturing concern, ing the De Laval Separator Co., of Poughkeepsie, N. Y., and that their for advocating the system was that they imported from their factories len and Germany the parts for the machinery which they built; that country they only assembled. Hence their reason for advocating ric system was because the parts were made abroad to metric dimen-

nost charitable view is that they did not know the facts, which are that arator company's business was established in this country some 35 go; that all of the parts were made to English dimensions until about s ago, when they were changed to the metric, without any reference to ade abroad.
arts are imported from Sweden, excepting about 100 special machines r, too small a quantity to be manufactured in this country, and also repair parts for very old machines originally built there. No parts er have ever been imported from Germany, and the total importations ery small fraction of 1 per cent, all parts being manufactured in this for machines built in the last 20 years.
e reason to believe that other statements put forth by the opposition little to them. So much for that.
l, Senator, want to touch on the compulsory adoption of the metric

CHAIRMAN. Have you anything different from what already appears in ord on that point?
MILLER. I do not know.
CHAIRMAN. Have you read the record?
MILLER. Not all of it. But I will be very brief.
CHAIRMAN. Very well.
MILLER. It is contended that the metric system can be used alongside other system, and that it should not be compulsory. But it is fair to e the system of measurement with the monetary system.
lecimal monetary system was of necessity made the only legal standard es, and it was necessary, because it had to be used nation wide or not If it had been optional we would still really be using pounds, shillings, nce. Any system which must of necessity be nation wide in its use declared the only standard. That is all.

Mr. RICHARDS. May I ask, Senator, that Mr. Roberts, who has prepared little material in concrete form, be permitted to make a statement?

The CHAIRMAN. Yes. Have you prepared a brief?

Mr. ROBERTS. Yes; I have a brief.

STATEMENT OF MR. FREDERIC L. ROBERTS, WASHINGTON REPRESENTATIVE AMERICAN METRIC ASSOCIATION.

The CHAIRMAN. Let us have your full name, residence, and occupation.

Mr. ROBERTS. Frederic L. Roberts, Congress Hall, Washington, D. C., Washington representative American Metric Association.

I would like at this time to submit for the record some material which I have prepared.

The CHAIRMAN. You want this all to go in the record, do you?

Mr. ROBERTS. Yes, sir.

The CHAIRMAN. Very well; it may be inserted.

(The brief referred to is as follows:)

I take it, Mr. Chairman, that you have been profoundly impressed during these hearings with the many different factions in our commercial, educational, and social life which are pressing for the enactment of legislation to secure the advantages of the metric system for the American people. It is generally admitted that there has never been a measure before Congress which was more free from class favoritism and which would really benefit a greater number of our fellow citizens. Whatever political party is in power when this bill is passed will naturally reap the golden harvest when the people realize that they are actually receiving even greater economic and educational advantages than they had anticipated.

Manufacturers, represented in the type of Samuel M. Vauclain, president of the Baldwin Locomotive Works, and Elwood Haynes, president of the Haynes Automobile Co.; merchants, represented by Arthur P. Williams, the wholesale grocer of New York City, who told you about the retail and wholesale grocers favoring the change; farmers, represented by the able Dr. Harvey W. Wiley; the scientific and educational world, already known to be practically a unit in favor of the adoption of the metric system, have struck a common chord with labor in supporting the adoption of the metric system by the United States.

Resolutions urging it have been passed by labor organizations such as the International Brotherhood of Electrical Workers, 180,000 members. In this connection, the following statement given out by Samuel Gompers at Atlantic City on June 12, 1919, will doubtless prove of interest to the committee and to Congress: "I firmly believe and long have believed that the metric system offers a return to simplicity, offers an effectiveness of thought, offers much even to children in our schools which we are not justified in withholding from them. The metric system is winning its way entirely on its merits, just as it should, because it is easy to learn, to work with, and best suited for practical purposes."

I again say, Mr. Chairman, that the consolidation of such varied and complete representative interests in a matter that is absolutely free from political entanglements almost automatically demands its early consideration by the United States Congress, which has the power to carry out the will of the people.

Of course there is a certain amount of opposition. As Benjamin Franklin states in a letter printed in his autobiography: "The objection you make to rectifying our alphabet, that 'it will be attended with inconveniences and difficulties,' is a natural one, for it always occurs when any reform is proposed, whether in religion, government, laws, and even down as low as roads and wheel carriages. The true question then is not whether there will be any difficulties or inconveniences, but whether the difficulties may not be surmounted, and whether the conveniences will not on the whole be greater than the inconveniences. In this case the difficulties are only in the beginning of the progress. When they are overcome the advantages are lasting." And I repeat Franklin's last four words with due emphasis, "the advantages are lasting," and let me say nothing is more true than this when applied to the advantages of the metric system.

In our testimony, Mr. Chairman, we have shown (1) the merits of the metric system, and (2) that the merits of the metric system are sufficient to justify a *well-established* industrial nation in changing their standards. In doing this *we showed the* deficiencies of the present jumble of weights and measures in

comparison with the rare possibility of our gaining the sought-for peace and prosperity by being individual in our system of measuring.

We also showed conclusively that the confusion which would result during the transition period has been grossly exaggerated and would be hardly distinguishable. In doing this we have not only cited cases and shown facts that prove that the change would be convenient and practical, but have shown that the cost would be offset almost immediately by the advantages that would accrue. It should be constantly borne in mind that the expense involved in the change is estimated on the following theories: (1) That the change is to be compulsory, and (2) that everything must be made to even metric dimensions. Neither of these assumptions is correct, as the change at the most need only be made as rapidly as manufacturers adopt new designs, and no convenient size need be changed even under the metric system.

We have shown, the oppositions artfully figured figures notwithstanding, that the units of the metric system lend themselves readily and easily to practical use in the United States, for the manufacture of fine machinery, in our commercial transactions and elsewhere. We also showed that our commerce is with nations that have long since adopted the metric system, and if we want to increase our industries and general wealth we must needs increase the amount of our trade other than that within our own boundary lines.

In showing the merits of the metric system we have shown that there are numberless advantages to be expected besides the mere use of decimals it gives us. The essential advantages of the metric system can not be obtained by resorting to the use of tenths, hundredths, and thousandths of any specific unit.

Furthermore, we have shown that the metric system is scientific, and ideal. As Gen. Pershing has said, "This is the only system that is based on scientific principles."

One thing I would like to ask, Mr. Chairman, is, "if we are to have a universal system eventually, is it more logical to reason that some 40 countries all using the same system of weights and measures will change over to one of the two individual systems being used by either Great Britain or the United States, or is it more logical that the change will be made by us and to the metric system?

In answer to the opposition who will immediately say, "Very well, if we must change but this is not the time for such a move," let me state that the United States Chamber of Commerce Metric System Committee voted the question one of nation-wide importance and timely. Furthermore, that the time to change seems to me to be when the wheels of progress are slowed down and not when business is in full swing. Another point, I repeat is the fact that a good many of our men, the men who were in the Army during the war, the men who made the munitions, the guns, and the implements used in the war have all become acquainted with the system and it is fresh in their minds.

In concluding I would like to have inserted in the records the following papers and indorsements.

FREDERIC L. ROBERTS,
Washington Representative American Metric Association.

ABSTRACTS FROM LETTERS OF INDORSEMENT BY UNITED STATES OFFCIALS.

UNITED STATES DEPARTMENT OF AGRICULTURE,
BUREAU OF CHEMISTRY,
Washington, D. C., March 18, 1920.

I beg to say without hesitation that the introduction of this system [metric system] would save a vast amount of confusion and unnecessary labor now made necessary by the irrational system in use.

CARL L. ALSBERG. *Chief.*

DEPARTMENT OF THE INTERIOR,
Washington, D. C., April 1, 1920.

The value of the metric system of weights and measures has been demonstrated and should be adopted by the United States. It is much more simple than our present cumbersome system of weights and measures.

JOHN BARTON PAYNE, *Secretary.*

PAN AMERICAN UNION,
Washington, D. C., December 16, 1920.

I have examined at one time or another all the contentions of those who opposed the adoption of the metric system and I find no valid ground for the allegation sometimes made that the change will involve widespread loss and confusion. The change need not be made overnight; there will be time for adjustment of appliances in the industrial world generally, and time for the schools and the press to familiarize the public generally with the units and terminology of the new system.

L. S. ROWE, *Director General.*

DIVISION OF MEDICAL EDUCATION,
ROCKEFELLER FOUNDATION,
March 1, 1920.

In my former work as pathologist I constantly used the metric system as the only system applicable to scientific work. My experience with it in this connection leads me to believe that it should be universally adopted.

This opinion has been strengthened by my experience in foreign countries, especially Latin-American countries where it appears to be used without the slightest difficulty and greatly to the advancement of science and commerce.

DR. RICHARD M. PEARCE, *General Director.*

UNITED STATES LEGATION,
Caracas, Venezuela, November 25, 1919.

South Americans do not like, understand, or care to learn the American and English system of weights and measures and only use them when forced down their throats. The metric system is more systematic, easier to learn, and easier to apply than our own. Our foreign commercial competitors use the metric system and have a great advantage over us in South America.

It stands to reason that an adoption of the metric system could be effected gradually and without any great inconvenience or monetary loss to our industries, and undoubtedly an adoption of this system would eventually lead to a monetary advantage on our part in South America alone far offsetting any possible loss to American industries as feared by some objectors to the same in the United States.

JOHN F. LANDIS, *Major,*
Military Attaché.

AMERICAN EXPEDITIONARY FORCES,
COMMANDER IN CHIEF,
November 24, 1919.

The experience of the American Expeditionary Forces in France showed that Americans were able readily to change from our existing system of weights and measures to the metric system. I think the principal advantages of the metric system are summed up in the fact that this is the only system which has a purely scientific basis. Not the least advantage of the fact that metric system is based on scientific principles is the facility which that system gives to calculations of all kinds, from the simplest to the most complex.

I believe that it would be very desirable to extend the use of the metric system in the United States to the greatest possible extent.

JOHN J. PERSHING.

UNITED STATES FOREST PRODUCTS LABORATORY,
Madison, Wis.

For instance, the sections of pulp and paper and derived products, largely devoting their research in chemical lines, use the metric system almost exclusively in their work. Timber mechanics use the metric system in weights up to 500 grams because it is more convenient than using pounds and ounces. On all large pieces handled in this section and in timber physics the English system is used, largely because the scales of sufficient capacity are all in the system in common use. For liquid measures the metric system is used practically

exclusively throughout all the laboratory, but for the solid values the regular system is used. The net opinion, after all is said, is that for all technical work the laboratory prefers the metric system because of its obvious value in reducing errors and work.

NATIONAL RESEARCH COUNCIL,
Washington, D. C., December 15, 1921.

Moved that the National Research Council is in favor of the extension by law of the use of the metric system in commercial transactions in the United States.

Adopted.

This action of the council may, of course, be referred to and made public by you in any way you please.

VERNON KELLOGG, *Permanent Secretary.*

NATIONAL ACADEMY OF SCIENCES,
SMITHSONIAN INSTITUTION,
Washington, D. C., December 1, 1921.

Any measure that might now be passed is tolerably certain to need modification and amendment before the end of the probationary period.

I received a report from the Committee on Weights and Measures and Coinage, which was authorized to act for the National Academy of Sciences, approving bill S. 2267.

CHARLES D. WALCOTT, *President.*

ABSTRACTS FROM LETTERS OF DISARMAMENT CONFERENCE DELEGATES.

WASHINGTON DISARMAMENT CONFERENCE,
BRITISH EMPIRE DELEGATION,
January 27, 1922.

In reply I desire to say that if it were found possible to standardize weights and measures throughout the world, it would facilitate trade, which, in opinion, would in turn promote common interests and peace among nations.

G. F. PEARCE,
Australian Representative.

BRITISH EMPIRE DELEGATION,
February 2, 1922.

I am in favor of this reform (adoption of a universal system) just as I support every measure which tends toward the unification of the human race and the breaking down of needless and therefore mischievous distinctions between nations.

JOHN W. SALMOND,
Conference on Limitation of Armaments.

JAPANESE DELEGATION,
WASHINGTON DISARMAMENT CONFERENCE,
November 26, 1921.

Last April a law adopting the international metric system as the single standard of weights and measures was passed by the Imperial Diet of Japan, and it was publicly announced that the date of its enforcement would be promulgated by an imperial ordinance. This action was taken after a thorough investigation, made by a special commission to simplify our standards of weights and measures.

We were unofficially informed that the United States and Great Britain were also planning to adopt the metric system, and it is our personal hope that the time will soon come when this uniform system will be universally adopted by all the countries in the world.

T. KATO, *Admiral.*
PRINCE TOKUGAWA.

ABSTRACTS FROM LETTERS OF VARIED SOURCES.

BRITISH CHAMBERS OF COMMERCE,
Toronto, September 23, 1920.

Resolved, That this congress of chambers of commerce of the British Empire in meeting duly assembled urges world uniformity of units of weights and measures as a means of facilitating commerce through coordination, standardization, and simplification; and further, that the British Empire and the United States of America forthwith standardize on the metric system solely.

Adopted.

There can be no doubt, I think, whatever, that the judgment of the whole civilized world, not excluding the countries which still adhere to the antiquated system under which we suffer, has long decided that the metric system is the only rational system.

The Right Hon. A. J. BALFOUR.

WASHINGTON, *December 5, 1921.*

Belgium adopted the metric system as far back as the end of the eighteenth century, and economically, as well as scientifically, has derived from it great advantages. One readily understands this fact when one remembers the difficulties which complicated the most usual commercial relations between the inhabitants of the different Provinces of old Belgium where various standards of weights and measures existed.

I am convinced that when the metric system will have become common to all civilized nations a true progress will have been achieved.

Baron de CARTIER de MARCHIENNE,
Belgian Ambassador to the United States.

WASHINGTON, *November 17, 1919.*

The Algemeen Handelsblad, of Amsterdam, for October 28, 1919, contains an article stating that on September 1 the meter was introduced as a unit of measure in all Poland. The use of other measures is now prohibited under penalty, and the goods so sold may even be confiscated. Bills and accounts must be expressed in metric units.

R. S. MACELWEE,
Acting Director Bureau of Foreign and Domestic Commerce.
Department of Commerce.

INTERNATIONAL LABOR CONFERENCE,
Washington, D. C., November 25, 1919.

The international metric system of weights and measures is the only legal system in Argentina. Metric weights and measures are used exclusively. No other system is tolerated within the Republic.

Dr. ALEJANDRO M. UNSAIN,
Vice President National Department of Labor, Argentina.

ABSTRACTS FROM LETTERS OF INDORSEMENTS BY FIRMS AND INDIVIDUALS.

FELT & TARRANT MANUFACTURING CO.,
Chicago, Ill., February 1, 1922.

DEAR SENATOR: I beg to express my earnest desire that Senate bill No. 2267, introduced by yourself, may become a law. As a matter of fact, I like it better as originally introduced than since amendments have been added to it.

I believe the difficulties to be experienced during the period of change have been very much exaggerated but that, even though they were not overdrawn, the benefits of the metric system would soon far offset any inconvenience during the period of transition. Without a doubt it would save much time now lost

by children in acquiring a thorough knowledge of our present complex system of weights and measurements and how to compute them. It would simplify commercial and engineering computations to an extent which would result in an enormous annual saving in an economic sense. It would put us in accord with the majority of the countries with whom we desire to do business, and it is my belief that, were America to adopt the metric system, Great Britain would do so.

Those in the metal trades who exaggerate the difficulty of mechanics learning to use the metric system seem to forget that a large percentage of the mechanics in America learned their trade under the metric system. This, together with the fact that a great many American soldiers acquired a working knowledge of the metric system during the war makes the present a good time to change our system of notation.

I am quite well aware that some manufacturers are opposed to the introduction of the metric system. That is to be expected. The human race is very reluctant to change to better methods, especially where is involves even a little bit of learning something new. It seems to require a trip hammer to effect any general movement in line of progress.

I am quite conscious of what would be necessary to adapt our machinery and drawings and train workmen for the use of the metric system, but am willing to make that change, which would not be serious either from the standpoint of expense or loss of efficiency during the transition from the old system to the new. To this company, of course, the greatest loss would result from restriction of the sale of calculators which the introduction of the metric system would bring about. However, I am willing to stand even that in the interests of the general welfare.

Our experience in selling calculating machines in Great Britain and the United States, as well as in many countries where the metric system is standard, convinces me that in domestic, as well as in international business the denominal system places any country at a great disadvantage as compared to countries having a purely decimal system.

A calculating mechine handles denominal numbers almost as easly as decimal numbers. Therefore, we have found it very much easier to introduce and to sell comptometers in countries which do not have the metric system. This was emphasized during the war by action of the British Government in facilitating shipments of comptometers on a par with war munitions, while France, with a metric system, could afford to put an embargo on the import of all mechanical calculators to help exchange.

Only after years of practice can a man become efficient in mentally multiplying and dividing British currency, therefore the British Government figured that a comptometer and an operator out of one of our schools could take the place of five expert computers who went to war.

D. E. Felt, *President.*

Bertschy Engineering Co.,
Cedar Rapids, Iowa, January 12, 1921.

World Metric Standardization Council,
San Francisco, Calif.

Gentlemen: Referring your letter of December 27 addressed to me care of Bertschy Manufacturing & Engineering Co., of Omaha, has pust been received. About a year ago I moved my plant from Omaha to this city and organized a new company. The Omaha company at the present time is operating as a sales organization; this explains my change in address.

I have on a number of occasions had opportunity to discuss the proposed adoption of the metric system in America. I have written personal letters to President Wilson, to the Bureau of Standards, and others in this country, and also to Lloyd-George in England strongly advocating the adoption of the metric system.

I have noted from time to time that many machine tool manufacturers are opposed to such a move. They are in nearly every case no doubt influenced by what they consider a heavy expense and inconvenience in changing their fixtures, dies, tools, jigs, etc., to conform with the metric measurements. They cannot be expected to give an unbiased opinion. While the executives may be personally in favor of such a change the fact that it touches their pocketbook is in most cases the basis for their objection.

You will note from the inclosed circular that we are manufacturers of a high-grade machine tool. We are catering to the foreign as well as domestic

trade. Personally, I feel rather silly when I stop to think that I am sending one of our machine tools manufactured according to American standards to a foreign customer and ultimate user. If the average machine-tool manufacturer would take the time or stop long enough to carefully check over the tracings or blue prints affecting his product he would himself become confused. No one of them have ever been able to rid themselves of the complex situation which arises, regardless of how careful and efficient the organization is. We deal now in sixty-fourths, thirty-seconds, sixteenths, eighths, quarters, and when our engineers desire to specify a tolerance they can not refer to it as sixty-fourths, they must therefore specify one-thousandths; on the other hand, for certain taps we use a letter-size drill, others require a number drill; again we have to use the drills in sixty-fourths and so on down the line until we have accumulated a large stock of tools, saying nothing about the fixtures and jigs, but referring only to drills, reamers, taps, and similar other standard or manufactured tools which could be reduced by one-half if the metric system were adopted; therefore, the statement made by some that it would be an expensive change is not founded upon actual facts. Personally, I consider it of vital importance that the present system be entirely eliminated. Any mechanic that calls himself an American and who looks forward to trade and intercourse with foreign peoples, must of a necessity be of the same opinion. This is regardless of the fact that the system that we are using at present is of German origin, yet it is not used by the Germans to any great extent. This in itself should be sufficient incentive for any broad-minded American to advocate a much needed change from the present jumble of unsatisfactory standards to the metric system.

Another point which perhaps has been brought out by others, the loss of time in arriving at the decimal equivalents often necessary in designs in this country, and using our present standards, is in itself a very important item so far as time and money are concerned. Furthermore, the errors made by mechanics very frequently by experts in their line, which cost their employers a large amount annually, can be almost entirely eliminated.

It is a notable fact that a child can easily and quickly be taught that there are ten pennies in 1 dime, and it soon follows that the child will learn that 10 dimes make $1. If one would reflect a moment and consider what would happen if you told a child that three-sixty-fourths is a little larger than a thirty-second, and that there are eight-eighths in 1 inch, and also sixteen-sixteenths, four-fourths, sixty-four-sixty-fourths, etc. To instill this in the mind of the average scholar in the lower grades of our public schools has proved somewhat of a problem because it involves mathematical ability. If it were only necessary to teach a scholar the fractions of inches and feet it would not be quite as bad, but we have to familiarize them with yards, rods, links, chains, etc. Then again we have pints, quarts, gallons, half-pecks, pecks, bushels, and whatnot; also half-barrels, barrels, hogsheads, and anything else that some manufacturer may devise for his own convenience and applicable to his product only.

If we adopted the metric system of weights and measures, the child that learns in a short time that 10 pennies make 1 dime would just as easily memorize or learn the metric system of weights and measures, because it is upon this that our monetary system is constructed. It has undoubtedly proven successful. Then, for what reason should it not be satisfactory for weights and measures?

I think I have made myself quite clear, and will be glad to assist in every way possible to bring about the change that is vitally necessary, and which will be as great a benefit to America as any improvement or invention that has ever become of commercial value.

A. J. P. BERTSCHY,
President and General Manager.

OMAHA, NEBR., *December 27, 1919.*

The Right Hon. DAVID LLOYD-GEORGE,
House of Parliament, London, England.

HONORABLE SIR: You are undoubtedly conversant with the fact that American and English Governments were materially handicapped during the war because neither one used the metric system of weights and measures. The writer was engaged upon work for the Air Service in America, and one of our chief sources of delay was the conversion of metric measurement into decimal and fractional measurements used in America.

In 1871 Germany scrapped the old jumble of measurements and weights and adopted the metric system, which, as a matter of fact, was invented by a truly great Britain in 1783—James Watt.

It is understood that there is at the present time a move on foot in England to adopt the metric plan to the English coins. America has long since adopted this plan; but she, like England, failed to see the importance of adopting the metric measures and weights.

It is thought that you will agree that we would hardly consider going back to the hand loom and pack horse and abandon the printing press, telephone, telegraph, railroad, steamship, and airplane; then, why do we continue to tolerate the antiquated system of weights and measures, which America and England seem to adhere to?

Those that say that this change can not be made without great loss are nothing more than profiteers. A gradual change to the metric system can be brought about without loss or ill effects to industry.

Suppose that Germany, after she had increased her own efficiency in war and trade by use of metric standards, had tried to forbid all English-speaking people the use of Watt's invention and had tried to compel them to keep on using the antiquated German jumble, what would you think? Would you approve it? Any public-spirited citizen or official in England or America should use every effort to bring about a speedy adoption of the metric system of weights and measures.

I ask you, sir, for your support, which I feel confident that you will give when you have compared data and studied the facts in the case.

A. J. P. BERTSCHY,
President Bertschy Manufacturing & Engineering Co.

The CHAIRMAN. Mr. Hubbard, did you have anything to offer?

Mr. HUBBARD. I did not, Senator, unless you have some questions to ask concerning the system.

The CHAIRMAN. At the request of Mr. Aubrey Drury, secretary of the World Metric Standardization Council, there will be printed a brief.

(The brief referred to is printed in full, as follows:)

ORGANIZED EFFORT FOR WORLD METRIC STANDARDIZATION.

Organization is the fundamental of success. The success and rapid progress of the metric standardization movement within the United States of America during recent years is due to organization—not to any single organization, nor to any group of organizations, but rather to the combined effort of hundreds of associations working effectively together. Their united purpose has been to secure the benefits of the world standards for the United States of America.

Here it is proposed to survey the associations, national and local, within the United States of America which are active in urging metric legislation. The metric work of international associations in which the United States is largely interested will also be outlined.

VAST ORGANIZED METRIC SUPPORT.

Each organization has its own way of aiding the cause of world standardization. Some publish material for distribution, advocating metrics; some concentrate their effort upon obtaining legislative support for the metric standards; still others devote their energies to unifying their members in advocacy of the decimal metric advance, often securing the actual and successful employment of metric units throughout important industries. Local organizations often aid the cause by holding public discussions upon this vital topic and by the appointment of special standardization committees.

Thus the metric advocacy is characterized by a variety of methods, which adds greatly to its effectiveness and does not detract from its singleness and unselfishness of purpose. It is remarkable, too, for the broad range of support accorded it. Whereas virtually all the organized obstruction to the metric advance comes from one small group, the movement is being urged by associations as broad as the Nation itself and representing every vocation—organizations of manufacturers, merchandisers, packers, builders, growers, inventors, scientists, educators; organized labor; organized farmers; organized women; organized warriors; and, in fact, associations of every kind.

AMERICAN METRIC ASSOCIATION.

In the forefront of the organized forces working for metric standardization is the American Metric Association. This association was established in 1916, carrying forward and directing an educational metric movement then definitely under way. The teachings of the World War as to the necessity for world metric standardization gave dramatic force from the outset to the patriotic work of the American Metric Association. The association has done much to unify and focus support for metric standards throughout the United States of America, and has rendered a very practical service in facilitating the introduction and actual use of metric units in hundreds of industrial concerns. It has effectively impressed upon the United States Congress the need for prompt adoption of the metric units, and has been ably represented in the hearings before the congressional metric committees. Its publications on metric standardization have been widely distributed, and their scope and value are indicated in chapter 14 of the present volume, "Look it up."

The American Metric Association works in cooperation with the World Metric Standardization Council, the World Trade Club, the British decimal associations, and has among its own membership such powerful metric urgers as the American Association for the Advancement of Science, American Chemical Society, American Drug Manufacturers' Association, American Institute of Chemical Engineers, American Pharmaceutical Association, American Association of Retail Druggists, National Canners' Association, National Scale Men's Association, National Wholesale Druggists' Association, National Wholesale Grocers' Association, and many others.

CONVENTIONS OF METRIC URGERS.

The annual conventions of the American Metric Association have attracted wide interest. They have been held in New York City, Chicago, Baltimore, St. Louis, Pittsburgh, and Toronto, and the American Metric Association was represented by its secretary, and by many other delegates in the great World Metric Standardization Conference in San Francisco May 17, 1920. Notable speakers have addressed all these gatherings. Among those who have spoken before the American Metric Association are: William C. Redfield, for seven years United States Secretary of Commerce, and twice president of the American Manufacturers' Export Association; Samuel Vauclain, president of the Baldwin Locomotive Works; Fred J. Miller, president of the American Society of Mechanical Engineers; F. O. Wells, for 20 years president of the Greenfield (Mass.) Tap, Die, Machine Tool Co.; Jesse M. Smith, former president of the American Society of Mechanical Engineers; George F. Kunz, vice president of Tiffany's and the world's greatest gem expert; J. H. Dunlap, Goodyear Tire & Rubber Co.; H. T. Wade, editor, New International Encyclopedia; C. A. Adams, consulting electrical engineer; A. E. Kennelly, consulting electrical engineer and professor at the Massachusetts Institute of Technology, and Harvard University; John Barrett, director general of the Pan American Union; W. C. Wells, chief statistician of the Pan American Union; J. W. McEachren, Crane Valve Co., Chicago, Ill.; F. R. Drake, of Drake & Co., Easton, Pa.; C. O. Mailloux, president of the International Electrotechnical Commission; Maj. Louis A. Fischer, chief of the Division of Weights and Measures, United States Bureau of Standards; David A. Molitor, consulting engineer, Detriot; G. H. Coakley, manager of the supply department and purchasing agent of the Automobile Club of America; Dr. Henry L. Taylor, Board of Education of the State of New York; Joseph J. Holwell of the mayor's bureau of weights and measures of the city of New York; Walter Wood, president of the Wood Iron & Steel Co., Philadelphia, and scores of other eminent authorities.

The American Metric Association has headquarters at 156 Fifth Avenue, New York City, and also has sections in various parts of the country. The officers for 1922 are George F. Kunz, president; William Jay Schieffelin, treasurer; and Howard Richards, secretary. Among the hundreds of members of the American Metric Association are numbered such men as Alexander Graham Bell, Joseph V. Collins; Gano Dunn, president of the J. G. White Engineering Corporation; Irving Fisher; J. E. Fries, of the Tennessee Coal, Iron & Railroad Co. (steel manufacturers); Albert Herbert; Jeannot Hostmann; Rear Admiral T. W. Kinkaid, United States Naval Engineering Experiment Station, Annapolis, Md.; A. S. Krebs, treasurer of the Krebs Pig-

ent & Chemical Co., Newport, Del.; Fred Mason, president of the Shredded heat Co., Niagara Falls, N. Y.; Maj. Fred J. Miller; Everett Morss, president Simplex Wire & Cable Co., Boston, Mass.; Charles P. Steinmetz, world electrical expert, Schenectady, N. Y.; Dr. S. W. Stratton, Washington, D. C.; William L. Sweet, Rumford Chemical Works, Providence, R. I.; William C. Wells, Pan American Union, Washington, D. C.; Frank O. Wells, Greenfield, Mass.; Arthur P. Williams, New York City; Theodore F. Whitmarsh, New York City, and others of like high standing in business and world affairs.

GREAT INDUSTRIAL CONCERNS AID.

The list of great industrial concerns holding firm membership in the American Metric Association is too long to be given here in full. Among them are the American Can Co.; Apothecaries Hall Co.; Austin Nichols & Co.; Bayer Co.; Beech-Nut Packing Co.; R. L. Craig & Co., Los Angeles; Crane Co.; Crocker-Wheeler & Co., Ampere, N. J.; De Laval Separator Co., Poughkeepsie, N. Y.; Detroit Stove Works; Diamond Crystal Salt Co., St. Clair, Mich.; Eimer & Amend; Foulds Milling Co., Chicago; Franklin Sugar Refining Co., Philadelphia; Frank L. Fuller & Co., New York City; General Electric Co.; Genesee Pure Food Co.; Getz Bros. & Co., San Francisco; Goerz American Optical Co.; Goodyear Tire & Rubber Co.; Haas Bros., San Francisco; Kellogg Toasted Corn Flakes Co.; Lawrence & Co., New York City (cotton goods); Lindley & Co., wholesale grocers, Sacramento, Calif.; Lufkin Rule Co.; Mendelson Corporation, New York City; Merrell Chemical Co., Cincinnati; Michigan Drug Co., Detroit; Minute Tapioca Co.; Pfanstiehl Co., North Chicago, Ill.; Raymond Concrete Pile Co., New York City; Rendrock Powder Co., New York City; Rumford Chemical Works; Runkel Bros., New York City; Seaboast Canning Co., New York City; Shredded Wheat Co.; S. K. F. Ball Bearing Co.; Square D Co., Detroit; Sussman, Wormser & Co., San Francisco; O. & W. Thum Co., Grand Rapids, Mich.; R. C. Williams & Co., New York City; J. B. Williams Co., Glastonbury, Conn.; American Insulated Wire & Cable Co., and many others.

NATIONAL WHOLESALE GROCERS' ASSOCIATION.

Prominent among the organizations which have worked consistently for metric standardization in the United States of America is the National Wholesale Grocers' Association. On October 27 ,1921, Arthur P. Williams, of New York City, representing this great national organization, appeared before the United States Senate committee holding hearings on the metric system. He testified: "The National Wholesale Grocers have a membership of 868 of the largest firms and corporations in the grocery business in the United States. We employ approximately 275.000 people and do a business of over $3,000,000,000. For 10 consecutive years we have passed a unanimous resolution in favor of the immediate adoption of the metric system."

Typical of these resolutions is one passed at the Liberty Convention of the National Wholesale Grocers' Association, in Chicago, June 22, 1917: "That we indorse the efforts of the American Metric Association in furthering the use and adoption of the metric system in the United States by every means at our disposal, including financial assistance." The special metric system committee of this great commercial organization has been particularly active, and its valuable reports have been printed in the proceedings of the annual convention since 1912. The National Wholesale Grocers' Association had delegates at the World Metric Standardization Conference, held in San Francisco, May 17, 1920, and it is ably represented on the metric system committee of the Chamber of Commerce of the United States by Maj. Fred R. Drake, of Easton, Pa.

The national Wholesale Grocers' Association has long urged its members to adopt the metric weights and measures on the labels of canned goods and other food products, using a double marking, including the old "British" or "American" weight or measure where required. This policy has been adopted as of vast educational value to the public, and particularly to develop the world trade of the United States of America. Billions of these metric labels have been printed and used.

It should be emphasized that the grocery business throughout the United States is a unit in advocating the advance to metric standardization. Many state organizations, wholesale and retail, have gone strongly on record in favor of the metric system. Such, for instance, is the New York Wholesale Grocers'

Association, comprising 126 of the largest wholesale grocery houses in the State of New York, doing an annual business amounting to over $300,000,000, and employing more than 58,000 workers. The Retail Grocers' Association of the United States has also been active in behalf of metrics.

ORGANIZED PHARMACY UNANIMOUS FOR METRICS.

Another powerful national commercial organization which has long supported the metric cause is the National Wholesale Druggists' Association. At its 1921 convention, held in Atlantic City, N. J., this association passed resolutions unanimously in favor of the world standards. The National Association of Retail Druggists, National Drug Trade Conference, National Association of Drug Clerks, and other organized units of this vast business are active in urging uniformity of weights and measures through general adoption of the meter-liter-gram.

On October 25, 1921, S. L. Hilton, president of the American Pharmaceutical Association, testified before the United States Senate committee investigating metric standardization. He declared: "The American Pharmaceutical Association has repeatedly gone on record favoring the metric system." The latest metric resolution was carried at the annual convention in New Orleans August, 1921. President Hilton calls attention to the fact that the United States Pharmacopoeia and the National Formulary use the metric units exclusively.

AMERICAN CHEMICAL SOCIETY.

The chemical industry ranks second, next to iron and steel, amongst the manufacturing industries of the United States of America. It is significant that this great industry is predominantly inclined toward exclusive use of the world metric standards. One important division of it, the American Chemical Society, is unanimously in favor of the metric system and is taking a leading part in the campaign to "make America metric."

On April 12, 1920, the council voted unanimously: "That in order to promote the cause of metric standardization the American Chemical Society should join heartily with the World Trade Club of San Francisco, with the American Metric Association, and with the London and Manchester Decimal Associations in forming a world metric standardization council, in calling a conference in San Francisco on May 17, 1920, with the object of promoting adoption of the meter-liter-gram system in the United States and throughout the world."

Doctor Parsons says: "We have always on all occasions taken the stand without one adverse vote, even in our large meetings where hundreds have been present, in favor of the adoption of the metric system." The American Chemical Society has a most active metric system committee under the chairmanship of Eugene C. Bingham, Lafayette College, Easton, Pa. This committee has conducted a systematic referendum among the universities and colleges throughout the United States of America, and virtually all of these have signified their intention to order chemicals and supplies in metric units only. The metric system committee has also gained widespread support for the metric standardization campaign from chemical manufacturers.

From the thousands of letters and resolutions from organizations it is appropriate to quote here a few. More can not be given because of lack of space. But it is important to know that great associations, both national and international in scope, and with hundreds and thousands of members, are working together for world unity of weights and measures upon the metric basis:

National Association of Electrical Contractors and Dealers, through W. H. Morton, general manager, New York City (January 24, 1921): After discussion the following resolution was adopted: "That the national executive committee favors the enactment of legislation which will bring in the use of metric weights and measures in commercial transactions after a sufficient number of years."

Electrical Manufacturers' Export Association of the United States of America (Inc.), Hudson Terminal Building, New York City, through W. B. McCurdy, secretary (June 3, 1919): "We are of the opinion that it is practical to make the change, and the good to be accomplished by such action will more than offset any expense or inconvenience which we may be put to. We are convinced that our weights and measures are a discredit to us, and we wish to eventually adopt the meter-liter-gram measurements."

National Association of the Motion Picture Industry, through F. H. Elliott, executive secretary, New York City, (November 3, 1920): The executive committee adopted this resolution unanimously:

"*Resolved*, That the National Association of the Motion Picture Industry (Inc.), in the interest of standardization, favors the enactment of legislation that will secure the advantages of the general use of metric weights and measures (international metric system) for the United States of America."

National Paper Box Manufacturers' Association, through William W. Baird, secretary, Philadelphia, Pa.: "We have prepared an article for publication in our monthly bulletin favorable to the metric system. We wish you all success in your endeavor." (Letter to the World Trade Club, February 17, 1920.)

4-One Box Makers' Association (National), through Francis H. McKeever, secretary-manager, Conway Building, Chicago (April 16, 1921): "In regard to the adoption of the metric system of weights and measures, the board of governors of this association is in favor of the proposed gradual standardization."

National Preservers and Fruit Products Association, Washington, D. C., through R. U. Delapenha (December 26, 1919): "At the annual convention of the National Preservers and Fruit Products Association, held in St. Louis December 19 and 20, resolutions were adopted and our secretary ordered to send messages to the President of the United States and to the Right Hon. Lloyd-George, the British Premier, recommending the prompt adoption of the metric system." Marcus Blakemore, president of the National Preservers and Fruit Products Association, declared (October 27, 1919): "The necessity for the universal adoption of the metric system seems unquestionable."

Salt Producers' Association (National), by D. B. Doremus, secretary, Detroit, Mich. (May 13, 1921): "At the last regular meeting of the Salt Producers' Association the members (who have, by the way, for some years past had considerable interest in this question) read and discussed the metric bill, S. 4675, with the result that the motion to express the approval of the members was supported and carried unanimously."

National American Association of Clothiers, through Irving Crane, secretary, New York City (November 17, 1919): "The executive committee of the National Association of Clothiers at its meeting held to-day indorsed the adoption of the metric system by the United States of America."

Manufacturing Perfumers' Association of the United States, through C. M. Baker, secretary, 309 Broadway, New York City: "The Manufacturing Perfumers' Association has cast its vote in favor of the adoption of the metric system. The resolution adopted at the annual meeting of our association held in New York, May 12, 1921, is as follows:

"Whereas the metric system of weights and measures possesses many advantages over the system at present in use in the United States; and

"Whereas the larger part of the raw materials entering into the manufacture of perfumes and toilet preparations are weighed and measured by the metric system; and

"Whereas there is now under consideration by the Congress of the United States a bill known as H. R. 10, introduced by the Hon. Fred Britten, which fixes the metric system of weights and measures as the single standard of weights and measures for certain uses: Be it therefore

"*Resolved*, That the Manufacturing Perfumers' Association of the United States, in annual convention assembled, indorses and urges the passage of H. R. 10; and be it further

"*Resolved*, That a copy of these resolutions be sent to the Committee on Coinage, Weights, and Measures of the House of Representatives."

On the executive board of this association are representatives of such well-known national advertisers as Gilbert Colgate, Colgate & Co.; V. Vivadou, of V. Vivadou (Inc.); Felix Lowy, the Palmolive Co.; F. C. Adams, Andrew Jergens Co.; C. M. Baker, Pond's Extract Co.; and others equally eminent in the field of manufacture.

American Surgical Trade Association, through F. B. Hovey, secretary, Chicago, Ill. (February 10, 1921): "The American Surgical Trade Association is in favor of the metric system of weights and measures, and heartily supports the measure now before Congress to provide for its general use in the United States. We are in favor of the United States going solidly upon the metric system, and, as far as I know, the bill which has been presented is as effective a method of obtaining this result as any that could be devised."

American Medical Trade Association declares itself officially in favor of the metric movement and has memorialized the American and British Governments to adopt the metric system of weights and measures. This is "a national association of manufacturers, dealers, and importers of surgical

instruments, hospital and office furniture, hospital and nurses' supplies, electro-medical and X-ray apparatus, orthopedic appliances and artificial limbs, laboratory equipment, surgical dressings and plaster, medical books, pharmaceutical and other allied lines."

American Association of Wholesale Opticians, through G. A. Henry, secretary-manager, New York City (March 14, 1921): "The metric system is absolutely essential and universally in use, when it comes to the measuring of things ophthalmic and in the establishment of standards according to which optical lenses are gauged or measured. Years ago in the ophthalmic field, when simple lenses only were used and before the advent of cylinder and compound lenses, the simple lenses (i. e., spheres) were gauged according to focal length in inches. With the advent of compound lenses (i. e., spheres combined with cylinders) it was soon found that the old system of indicating lens strength was cumbersome and impracticable. The metric system was adopted for indicating the strengths of ophthalmic lenses. The standard adopted was the meter."

Music Industries Chamber of Commerce of the United States of America, through Alfred L. Smith, general manager, New York City (February 2, 1921): "This chamber of commerce, at a meeting of its directors, went on record in favor of the metric system, but not in favor of any particular bill or methods whereby it should be brought about." This organization has the following division members: National Piano Manufacturers' Association of America, National Association of Music Merchants, National Music Roll Manufacturers' Association, National Musical Merchandise Association of the United States, Musical Supply Association of America, Music Publishers' Association of the United States, Band Instrument Manufacturers' Association, National Association of Talking Machine Jobbers, National Piano Travelers' Association, National Association of Piano Tuners, Organ Builders' Association of America. (It is interesting to note that James Watt, who worked out the metric plan and got it started into world-wide public use, built an organ to order as well as the first steam engine for world-wide use.)

National Shoe Wholesalers' Association, by Louis M. Taylor, secretary treasurer (July 12, 1920): "At a meeting of the executive committee of this association, held in Boston on July 8, I was designated to serve on the World Metric Standardization Council as an advisory representative of this association." The national organization is composed of Western Association of Shoe Wholesalers, Southern Shoe Wholesalers' Association, Middle States Shoe Wholesalers' Association, New England Shoe Wholesalers' Association.

National Association of Tanners (February 1, 1917):

"*Be it resolved*, That we, the board of directors of the National Association of Tanners, do hereby suggest to the board of directors of the Chamber of Commerce of the United States of America that they place before the constituent members of said chamber, in form of a referendum, the question of the advisability of the adoption of the metric system as the only legal standard of weights and measures in the United States."

American Specialty Manufacturers' Association, in annual convention, New York City (November 19, 1920):

"*Resolved*, That we reaffirm our position previously taken favorable to the eventual adoption of the international metric system of weights and measures in simplification of our present cumbersome system, and for the present recommend the double marking with the English weights and the metric equivalents, as of value in goods for export, and as of value for its educational advantages."

(A like resolution was adopted at the 1921 convention.)

American Pharmaceutical Association, through William B. Day, general secretary, Chicago (January 5, 1921):

"The American Pharmaceutical Association has been for years and is to-day an ardent advocate of the use of the metric system."

National Association of Drug Clerks, through P. A. Mandabach, secretary and treasurer: "The subject of the metric system is one upon which we have as early as 1910 adopted resolutions, asking organized pharmacy to take the initiative for universal international adoption." In annual convention a strong resolution was passed, from which this is an excerpt:

"Whereas the metric system of weights and measures is superior to the cumbersome system now in use in the United States; and

"Whereas the difficulties of transition from our system, or lack of system, to the metric system are largely imaginary; and, contrary to the prevailing

idea, weights will not have to be replaced, but merely readjusted, the scale beams remarked, and measures either adjusted or converted to containers; and

"Whereas this being a time of world reconstruction and a period of competition for leadership in science, industry, and the world's trade, it is essential that each branch of American activity be brought to the top notch of efficiency: Therefore be it

"*Resolved*, That the American National Association of Drug Clerks in annual convention assembled declares itself strongly in favor of immediate legislation to bring about the exclusive use of the metric system within the confines of the United States of America."

(The full text of this excellent resolution is printed in World Trade Club booklet 4, "Who urges meter-liter-gram?" p. 72.)

United States Sugar Manufacturers' Association has in 1921 gone on record in favor of gradual metric standardization, as proposed in bills now before Congress. The president of this national organization, Henry H. Rolapp, of Salt Lake City, Utah, has petitioned Congress to enact the metric standards bill.

American Woods Export Association, through Nelson C. Brown, secretary, 30 Church Street, New York City (November 18, 1920): "This association has given its hearty support to the metric system of measurements, and we trust that it may be adopted very promptly in this country, as there is no question of its many advantages." This position was reaffirmed unanimously at a meeting of the association held at the rooms of the Up-Town Club, 21 East Forty-fifth Street, New York City, February 5, 1921. Besides its offices in the United States this international organization maintains headquarters in Belgium, France, and Spain.

Association of American Steel Manufacturers, some years ago at a meeting held in Steelton, Pa., United States of America, adopted the following resolutions:

"*Resolved*, That this association hereby indorses House of Representatives bill No. 7251, establishing the metric system of weights and measures, and requests that the individual members of the association correspond with their Representatives and Senators urging its passage.

The firms and corporations represented at the meeting were as follows: Jones & Laughlin, Pittsburgh, Pa.; Carnegie Steel Co., Pittsburgh, Pa.; Cambria Iron & Steel Co., Johnstown, Pa.; Bethlehem Iron Co., South Bethlehem, Pa.;[1] Central Iron Works, Harrisburg, Pa.; Pottstown Iron Co., Pottstown, Pa.; Illinois Steel Co., Chicago, Ill.; Carbon Steel Co., Pittsburgh, Pa.; Park, Bro. & Co., Pittsburgh, Pa.; Lukens Iron & Steel Co., Coatesville, Pa.; Pennsylvania Steel Co., Steelton, Pa.; Colorado Fuel & Iron Co., Pueblo, Colo.

Sewing Machine Manufacturers' Association of the United States in 1921 went on record in favor of gradual metric standardization of weights and measures as proposed in the Britten-Ladd bill now before Congress. Among the members of this association are: Davis Sewing Machine Co., Dayton, Ohio; New Home Sewing Machine Co., Orange Mass.; White Sewing Machine Co., Cleveland, Ohio; Standard Sewing Machine Co., Cleveland, Ohio; Free Sewing Machine Co., Rockford, Ill.; National Sewing Machine Co., Belvidere, Ill.

National Foreign Trade Convention, group session, Pittsburgh, Pa. (January, 1917): The following resolution was adopted: "That the use of the metric system be adopted more widely, and, of course, used exclusively in quotations for foreign sales (except in England and the colonies)."

Commercial Union of America, through George H. Baston, 23–25 Beaver Street, New York City, (January 29, 1921): "We use the metric system quite extensively in our international trade, in quoting prices and so on. All prices on grain and flour to European countries are quoted in dollars and cents per 100 kilos. It is desirable to use this system, as it is understood in Europe, and we have not found any particular difficulties in its use." (See also favorable testimony of E. D. Horner, general manager, U. S. Congress metric system hearings, 1921, p. 166.)

American Society of Equity, Madison, Wis. (February 25, 1920): "We cover the States where the greatest quantity of farm products is produced and we are in favor of the metric system. The adoption of the metric system

[1] Charles M. Schwab is chairman Bethlehem Steel Corporation, 1922. The fact that Andrew Carnegie consistently urged world metric standardization is well known. (See Carnegie committee metric report.)

by the United States would greatly facilitate and reduce labor of computation and we believe it would be to the advantage of both instruction and practice." (This is an economic agricultural organization.)

National Consumers' Cooperative Association, through Rafael Mallen, organization department, Chicago, Ill. (May 24, 1920): "You may be sure that the National Consumers' Cooperative Association is in favor of the metric system. As a statistician, I have been unable many times to make a quick analysis of a situation because of the different systems of measures in the United States, Canada, and Mexico. It is a shame that the United States and Britain should not have adopted the metric system long ago." This organization is affiliated with the National Cooperative Association (wholesale).

The Swedish Chamber of Commerce of the United States of America, through G. Sundelius, secretary, Produce Exchange Building, New York City (December 14, 1920): "The board of directors is unanimous in going on record as favoring the metric system to attain world unity in weights and measures." Johan Riis, former secretary of this organization, declared (April 26, 1920): "I believe that the installation of the metric system would be very beneficial to the United States."

American Association for the Advancement of Science: Several years ago the American Association for the Advancement of Science went on record favoring the general adoption of the metric system in the United States. This national association literally represents all of the scientific organizations of America, so that, in the words of the eminent metric advocate, Dr. H. V. Arny, professor of chemistry at Columbia University, "Everybody knows where science stands. Among the national organizations represented by the council of the American Association for the Advancement of Science are: American Physical Society, American Chemical Society, American Astronomical Society, Geological Society of America, Association of American Geographers, Seismological Society of America, Entomological Society of America, American Society of Zoologists, American Association of Economic Entomologists, American Society of Naturalists, Ecological Society of America, American Genetic Association, American Microscopical Society, Botanial Society of America, American Phytopathological Society, American Anthropological Association, American Institute of Electrical Engineers, American Institute of Mining and Metallurgical Engineers, American Society of Civil Engineers, American Society of Mechanical Engineers, Illuminating Engineering Society, American Medical Association, National Society for the Study of Education, American Federation of Teachers of the Mathematical and Natural Sciences, Society of College Teachers of Education, The Society of Sigma Xi, American Meteorological Society, Optical Society of America, Eugenics Research Association, American Psychological Association, American Association of Anatomists, Society of American Bacteriologists, Society of American Foresters, American Society for Horticultural Science, Southern Education Society.

Among the associated societies of the American Association for the Advancement of Science are: The American Mathematical Society, Mathematical Association of America, American Electrochemical Society, American Institute of Chemical Engineers, Paleontological Society of America, American Alpine Club, National Council of Geography Teachers, the Wilson Ornithological Club, American Nature-Study Society, the Botanists of the Central States, American Folk Lore Society, Archaeological Institute of America, American Association for Labor Legislation, American Civic Association, American Economic Association, American Metric Association, American Sociological Society, American Statistical Association, Society for the Promotion of Engineering Education, American Society of Heating and Ventilating Engineers, American Society of Refrigerating Engineers, American Physiological Society, American Society of Biological Chemists, American Society for Pharmacology and Experimental Therapeutics, American Academy of Medicine, American Association of Neuro-Pathologists, American Public Health Association, American Society for Experimental Pathology, Society for Promotion of Agricultural Science, American Society of Agronomy, American Dairy Science Association, American Pomological Society, American Society of Animal Production, Association of Official Seed Analysts, the School Garden Association of America, American Association of University Professors, American Philosophical Association, Bibliographical Society of America, and many other scientific organizations, besides 15,000 individual members. Among the prime objects of the American Association for the Advancement of Science are "to facilitate research, the publication and dissemination of the results of research, and the prompt application of

these results in daily life." The association has consistently urged metric standardization of weights and measures, and its official weekly journal, Science, has published many excellent articles on this subject.

American Academy of Medicine, at its meeting held at Atlantic City, June 9 and 10, 1919, adopted the following: "The American Academy of Medicine recommends that the units of the metric system be adopted by the Congress of the United States and the British Parliament as the exclusive legal standards of weights and measures, and that the secretary of the academy is instructed to bring this minute to the attention of the President of the United States and the British Premier."

American Medical Association (82,000 members) has long been on record in favor of metric standardization. Typical of its position is the following resolution, adopted unanimously in annual convention:

"*Resolved,* (1) That the American Medical Association adopts the international metric system, and will use it in its transactions; (2) requests that those who present papers at its future meetings employ this system in their communications, or reprints thereof; (3) requests the medical boards of hospitals and dispensaries to adopt the metric system in prescribing and recording cases; and that the faculties of the medical and pharmaceutical schools adopt it in their didactic, clinical, or dispensing departments; (4) requests the physicians familiar with the metric system to help their confreres and the druggists in its application; and the delegates present at this session to work up the acceptance of the metric system by their respective county and State societies; (5) requests our president to name a metric executive committee, of which he shall be the ex officio chairman, and whose task will be to give unity and rapidity to this metric movement."

American Association of Pathologists and Bacteriologists, through Howard T. Karsner, secretary: At a meeting of the association held in New York City, April 2, 1920, it was "voted that the American Association of Pathologists and Bacteriologists indorse the adoption by the United States of America of the metric system of weights and measures." The organization has petitioned Congress to enact metric standards legislation.

American Nurses' Association, through Katherine DeWitt, secretary, Rochester, N. Y., July 2, 1919: "The board of directors of the American Nurses' Association has instructed me to express its approval of the universal use of the metric system."

American Physical Society at a meeting held in New York City, February 26, 1921, passed this resolution: "We urge the adoption of the decimal metric standards of weights and measures in the United States."

The Agassiz Association (a national scientific organization), through Edward F. Bigelow, president, Arcadia, Sound Beach, Conn.: "We are heartily in favor of the adoption of the metric or decimal basis of measurement, weight, and so on. We surely shall welcome the time when that system shall be used throughout the world. I am wondering why business men and mechanics have been so slow in recognizing its superior advantages."

Association of Amateur Scientists, through S. L. Shields, secretary, Brooklyn, N. Y., March 22, 1920: "Allow me, in the name of the Association of Amateur Scientists, to emphasize the urgent need of a meter-liter-gram system. It will greatly facilitate scientific work. Above all, it will bring the scientific ideas of the day more into the life of the community."

American Society for Testing Materials, by the executive committee, Philadelphia, Pa., February 16, 1920: "The society will begin to publish measurements in the present system with the metric equivalent immediately following in parentheses, except where the metric units are the universally accepted standards, in which case it is to be optional with the committee as to whether the present equivalent shall be given."

At the metric discussion held November 7, 1919, by the American Philosophical Society at their headquarters on Independence Square, in Philadelphia, Hon. William C. Redfield, formerly United States Secretary of Commerce, presented a paper entitled "An international treaty which resulted in a scientific league of nations." The paper gave a historical account of the metric treaty of May 20, 1875, which resulted in the establishment of the international committee on weights and measures, the international bureau of weights and measures, and provided for the construction of the international standards of length, capacity, and weight. Mr. Redfield also discussed the scientific significance of the establishment of the international bureau of weights and measures which is now maintained by the leading nations of the world (in-

cluding the United States of America and Britannia) at Sevres (St. Cloud, Bois de Boulogne Park), Paris, France, on international territory. This bureau has with great care prepared duplicates of the metric standards which are held by the various nations and whenever necessary compared with the original standards.

Association of Official Agricultural Chemists, October 26, 1921:

"*Resolved*, That this association indorses the proposal now under consideration by Congress that after due notice the metric system of weights and measures be made the legal system of the United States; and, also, to further the introduction of this system recommends that its members in the purchase of supplies designate and describe the same in terms of the metric system so far as possible."

American Institute of Chemical Engineers, through David Wesson, president, 120 Broadway, New York City: "I wish to give assurance that the American Institute of Chemical Engineers is heartily in favor of gradual metric standardization."

American Electrochemical Society, through its secretary, Joseph W. Richards, at its convention in Cleveland, Ohio, October 1, 1920, announced: "A referendum vote on the adoption of the metric system of weights and measures in this country (United States of America) showed that 484 members favored this system and 105 were opposed."

American Society of Electrical Engineers has long been on record strongly in favor of general adoption of the metric system throughout the United States. Some years ago the standardization committee reported resolutions in favor of the metric system to the board of directors, who referred the resolutions to the membership by letter ballot. The final vote, 1,569 in favor, 178 against. (No doubt at the present time, with the teachings of the World War, and the further entry of the United States into world affairs, the vote in favor would be even more decisive.) The resolutions adopted are as follows:

"Whereas the metric system of weights and measures offers very great advantages by its simplicity, consistency, and convenience in everyday use, as well as in engineering and scientific calculations and computations; and

"Whereas these advantages have already been demonstrated by the universal adoption and entirely successful use of the metric system in all civilized countries except the United States and Great Britain; and

"Whereas all the electrical units in universal use, such as the volt, ampere, ohm, watt, and so on, are metric units; and

"Whereas the industrial use of these electrical units would be facilitated by the general adoption of the metric system: Therefore

"*Resolved*, That this committee unanimously recommends the introduction of the metric system into general use in the United States at as early a date as possible with no undue hardship to the industrial interests involved.

"*Resolved*, That this committee favors such legislation by Congress as shall secure the adoption of the metric system by each department of the National Government as speedily as may be consistent with the public welfare."

Institute of Radio Engineers, through Alfred N. Goldsmith, secretary, New York City: "At its meeting of November 19, 1920, the board of direction of the Institute of Radio Engineers adopted the following resolution:

"Whereas the advantages of the metric system of measurement have been clearly demonstrated by its extensive use in radio engineering: Therefore be it

"*Resolved*, That the board of direction of the Institute of Radio Engineers favors the enactment of legislation by the United States Congress whereby the present system of weights and measures will be replaced by the metric system."

National Institute of Inventors, through Paul R. Fay, executive secretary, New York City, March 31, 1921: "The National Institute of Inventors is in favor of the metric system and approves of the metric standards bill now under consideration by the United States Congress. We are requesting members of the National Institute of Inventors in every State of the Union to write their national legislators urging the passage of this bill." This organization of several thousand members is giving its whole-hearted support to the cause of metric standardization, and holds membership in the World Trade Club and in the World Metric Standardization Council. It is also a member of the American Mining Congress, Associated Advertising Clubs of the World, Industrial Arts Council, and the Patent Office Society.

American Institute of Architects, through E. C. Kempes, secretary, Washington, D. C., September 12, 1919: "By direction of the executive committee, I am writing to advise that the American Institute of Architects for many years

has been in favor of the adoption of the metric system and has so expressed itself to the public and its membership on various occasions."

Railroad Yardmasters of America, Columbus, Ohio, April 19, 1920: "We have requested the British Government, as well as the Bureau of Weights and Measures of the United States, to adopt the metric system, and we are willing to cooperate along these lines. We are making reference to this matter in our monthly publication."

American Railway Bridge and Building Association, through C. A. Lichty, secretary, Chicago, "indorses legislation that will bring about the exclusive use of meter-liter-gram by the United States of America."

American Federation of Labor, through committee, at the thirty-ninth annual convention, Atlantic City, N. J., June 9–23, 1919: "In view of the demonstration by war conditions of the industrial and educational value of the metric system, the committee recommends that the executive council cause an investigation to be made of the advantages of the introduction of the metric system into this country, with a view to determine what further steps, such as congressional action, may be advisable."

After looking into the subject of metric standardization, the executive head of the American Federation of Labor, Samuel Gompers, came out unqualifiedly in favor of general adoption of the metric units and expressed his desire to aid in any way possible to bring about this result. (His statement is given elsewhere. See also statement in this chapter by Canuto Vargas, in behalf of the Pan American Federation of Labor.)

National Federation of Federal Employees, at its New Orleans convention, 1921, passed this resolution:

"Whereas the present system of weights and measures in use in the United States is cumbersome and not in complete harmony with any other nation of the world; and

"Whereas the present weights and measures are a source of constant nuisance, costly errors, loss of time, loss of effort, and a formidable obstacle to greater national efficiency and international cooperation; and

"Whereas the international metric system is the simplest system of weights and measures ever devised and has already been adopted in more than 34 countries of the world: Now, therefore, be it

"*Resolved*, That the National Federation of Federal Employees, in convention assembled, recommends the early passage of the Britten-Ladd bills—H. R. 10 and S. 2267—to secure for the people of the United States the advantages of the commercial use of the international metric system after a liberal period of 10 years."

International Brotherhood of Electrical Workers, with a membership of 180,000, at its annual convention in St. Louis, Mo., September 29, 1921, passed this resolution by a large vote: "*Resolved*, That the International Brotherhood of Electrical Workers, in convention assembled, recommends the enactment of legislation that will secure the advantages of the general use of metric weights and measures for the people of the United States, and that we also indorse H. R. 10 and S. 2267, bills calling for the commercial use of the metric system by the people of the United States after a transition period of 10 years."

National Catholic Welfare Council, through Rev. John J. Burke, C. S. P., general secretary, Washington, D. C.: "In connection with proposed legislation covering gradual introduction of metric system: The general idea contained in the proposed legislation seems to the officers of this council to be desirable." (Most Rev. Edward J. Hanna, D. D., San Francisco, is chairman of the National Catholic Welfare Council.)

National Council of Catholic Women of the National Catholic Welfare Council, through Agnes G. Regan, executive secretary, Washington, D. C. (March 15, 1921): "In regard to the metric standards bill now before Congress, the attitude of the National Catholic Welfare Council is favorable toward such legislation."

National Child Welfare Association, through Charles F. Powlison, general secretary, Educatonal Building, New York City (February 14, 1921): "It was resolved that the board of directors of the National Child Welfare Association (Inc.), recommend the use of the metric system in the interest of future generations in order to make uniform the use of weights and measures." (Judge William H. Wadhams, New York City, is president and Herbert Hoover, Washington, D. C., is vice president of the National Child Welfare Association.)

War Mothers of America, national executive headquarters, Evansville, Ind., by Beatrice Hillham, corresponding secretary (March 4, 1919): "Mrs. Morris asks

me to say that as president of the War Mothers of America she heartily indorses a movement to bring about the meter-liter-gram system of weights and measures in the United States. Such a movement would not only render mercantile transactions more simple, but would be another great step forward toward smooth international relations."

Many statements strongly urging metric standardization have been issued by executive officers of important national organizations, and in almost all cases these executives represent accurately the sentiment of the organizations as a whole. From among the hundreds of such statements which have been issued a typical selection may be presented:

F. C. Backus, secretary National Jewelers' Board of Trade (October 25, 1919): "Relative to the adoption of the metric system in the United States, I would state that the jewelers' vigilance committee, representing the jewelry trade, of which Mr. Harry C. Larter, 23 Maiden Lane, New York City, is chairman, has been interested in this subject for the past year, indorsing the same, and I understand that the committee will soon have a report to make to the trade approving the use of the metric system."

M. Wulpi, commissioner, Central Bureau of Extension Dining Table Manufacturers, Chicago, Ill. (February 4, 1920): "The writer has read with interest matter received from the World Trade Club and favors your effort, commending you in it." (Letter to the World Trade Club.)

D. D. Fennell, executive secretary National Association of Upholstered Furniture Manufacturers, Chicago, Ill. (March 19, 1921): "The writer, being an engineer, is completely committed to the metric standardization plan."

North Storms, secretary-treasurer National Glass Distributors' Association, Chicago, Ill. (March 24, 1921): "Personally, I believe we should change to the metric system, but could, of course, not speak officially for the association until it had expressed itself formally." The predecessor of Mr. Storms as secretary-treasurer, J. Roy Helm, wrote (October 17, 1919): "Many members of the National Glass Distributors' Association have displayed, since the end of the war, with a resultant expansion in their export business, an increasing interest in the metric system."

M. E. Holmes, manager chemical department National Lime Association (January 18, 1921): "I am firmly in sympathy with the plans of the World Metric Standardization Council and hope they go through."

Morris G. White, jr, manager foreign trade division, National Federation of Construction Industries, Philadelphia, Pa. (March 3, 1920): "In view of a recent experience, we are more than ever in favor of the adoption of the metric system."

Frederick Bode, president Millinery Chamber of Commerce of the United States of America (October 24, 1919): "I am personally decidedly in favor of the metric system. It has great advantages over our present system. There is no doubt in my mind that it would be of great advantage to the United States to adopt the metric system, especially as we are bound to wish to do export trade in countries in which the metric system is used."

Fred C. Taylor, secretary Millinery Jobbers' Association (National), Chicago, Ill. (February 9, 1921): "I am writing Congressman Britten, telling him what I think of the metric system. Having lived two years in South America, I can appreciate its merits. * * * I spent almost two years in the wilds of the Amazonian jungles during the construction of the Madria-Mamore Railway, in which connection I had much to do with weights and measures, as I had charge of several of the largest of the company's commissaries, and I wish to state that all of the bulk supplies, such as sugar, coffee, tea, and so on, were sold under the metric system.

"Those who claim at the metric system is not used in South America are making statements which they can not substantiate. Even up in the jungles the natives are familiar only with kilos, and all of the vast rubber business formerly done in that territory was measured by metric standards. Latin America long ago standardized her weights and measures to conform to metric units, and if some of these people who claim that this is not so would make a trip to such countries as Brazil, Argentina, Chile, and so on, they would very soon change their ideas.

"I trust that the metric standards may soon be adopted in the United States of America, as they are far superior to any other weight-measure system and are the only logical measurements."

Caswell A. Mayo, vice president National Pharmaceutical Service Association (April 15, 1920): "Both President Frank B. Cain, of the National Pharma-

ceutical Service Association, and myself are personally in favor of the adoption of the metric system."

Phil. Weiss, secretary American Registered Pharmacists, expresses (May 26, 1920) the support of that organization to secure the adoption of the metric system of weights and measures for the United States.

W. A. Gravett, secretary American Osteopathic Association, Dayton, Ohio (March 2, 1921): "Personally I favor the metric standards bill."

E. L. Fisk, medical director Life Extension Institute, New York City, N. Y.: "I am strongly in favor of metric units." (The president of this organization is Hon. William Howard Taft.)

Frank J. Osborne, executive secretary American Society for the Control of Cancer, New York City, N. Y. (March 4, 1921): "I feel that the effort of the World Metric Standardization Council should be supported, both on the grounds of uniformity with standards used by other civilized countries, and because of the scientific accuracy of the metric system. The gradual standardization such as contemplated in the metric standards bill should in the course of 10 years make it easily possible for the country to adopt the new standards without any serious difficulty."

William C. Groeniger, president American Society of Sanitary Engineering, Columbus, Ohio (March 16, 1920): "Our society is very much interested in the standardization of weights and measures. For years we have been hammering away upon the importance and necessity of standardization in plumbing and plumbing material. * * * Having been privileged to visit South Africa, Portuguese East Africa, India, Egypt, Palestine, Syria, Italy, and France during the World War, I appreciate the necessity of world standardization of weights and measures through the adoption of metric units." (William C. Groeniger is one of the directors of the National Bureau of Standardization of plumbing materials.)

R. C. Bailey, manager department of chapter activities American Association of Engineers: "The national board of directors of the American Association of Engineers, after considering this matter, recommended the subject of the adoption of the metric system in the United States as a proper one for the discussions of American Association of Engineers chapters. We have become actively interested in the extension of the metric system and its adoption as a standard in this country. As I look at it, the greatest saving in the exclusive use of the metric system is in engineering, and secondarily the saving of the time of educating, or the time required to gain an education." C. E. Drayer, secretary of the American Association of Engineers, states: "The national executive committee believes that the metric system is a question of such moment as to merit the active consideration of our members." (This great organization has more than 30,000 members, and a number of its chapters have gone on record in favor of gradual metric standardization. Its Engineers' Directory declares: "The American Association of Engineers is an organization of the same type as the United States Chamber of Commerce, or as the American Medical Society, American Institute of Architects, bar, or other professional organization. American Association of Engineers has been characterized as the Engineers' Chamber of Commerce. It expects to attain its economic ends by the application of intelligence, by a united front, and publicity.")

W. G. Calderwood, bureau of tax research, Minneapolis, Minn. (July 23, 1919): "Our clumsy and awkward conglomeration of weights and measures is not only difficult to learn but is inaccurate and confusing in its details. These lead to constant error and continuous fraud. I am exceedingly anxious to see them go."

Franklin D'Olier, first national commander American Legion: "I quite agree as to the merits of the metric system."

Edward P. Foster, secretary Universal Language Society, Marietta, Ohio: "Our present system of weights and measures, if it can properly be called a 'system,' is a medley—burdensome to the learner and the user, promotive of misunderstanding, prodigal in its waste of time, and antagonistic to the extension of trade and commerce throughout the world. I am glad to be associated with those who are working for the adoption of meter-liter-gram; that is, the scientific, common sense system." (J. V. McMillan, dean of Marietta College, is President of the Universal Language Society; W. V. Dick, president of the Safe-Cabinet Co., is its vice president.)

Louis D. Froelick, of the American Asiatic Association (March 26, 1920): "Thank you for sending copies of your publications on the metric system. Your

work is certainly comprehensive and well directed, and will undoubtedly bring results." (Letter to the World Trade Club.)

Erving Winslow, secretary The Anti-Imperialist League: "I am strongly favorable to the metric plan."

Albert Shiels, vice president Inter-Racial Council, and chairman executive board, National American Council (July 25, 1921): "I know that I am reflecting the opinion of many members of these organizations when I state that the adoption of the metric standards bills would be to the benefit of our country and injurious to no American interest. Those are of this opinion are impressed by the importance of the adoption of the metric system when made in the manner suggested by the legislation referred to, as it will not discommode the manufacturing industries. My personal experience as one of the superintendents in the school system of New York City and as city superintendent of the public schools of Los Angeles, Calif., has convinced me that the adoption of the metric system would be of inestimable value in two respects: From the standpoint of instruction it would so completely simplify the arithmetical teaching in our public schools as to permit time for instruction in other subjects pressing for attention. From the standpoint of business it would introduce a universal and simple standard of measurement that would promote the sale of our own products throughout the world. The English-speaking people would have a common basis of measurement; and we should reap the advantage of new markets now controlled by nations that enjoy a partial monopoly of South American trade because they use the measurements of their prospective customers."

George Haven Putnam, president Free Trade League: "I am personally fully in accord with the purpose of large-minded citizens throughout the world, to bring about the establishment of the metric system. I believe that such standardization of weghts and measures, with which may properly be included a standardization of the world's currency, must advance the understanding of commercial relations and tend to further the freedom of trade." (Mr. Putnam has also indorsed the metric standards as president of the American Rights League.)

Louise Stevens Bryant, educational secretary, national headquarters, Girl Scouts (May 18, 1920): "As a member of the American Statistical Association, I am very glad indeed to have opportunity to indorse the campaign for meter-liter-gram, and hope that the metric bill will pass in Congress."

Mollie Price Cook, secretary Child Conservation League of America: "I have taken pleasure in giving meter-liter-gram editorial mention in the May, 1920, number of Social Progress." (Winfield Scott Hall, president of the Child Conservation League of America, is a member of the advisory committee of the World Metric Standardization Council.)

Eric Schuler, secretary Authors' League of America (February 15, 1921): "Personally I am very strongly in favor of the metric system throughout the world, and I believe that a number of the members of our executive committee take the same stand."

William O. Stillman, president American Humane Association (April 28, 1920): "I favor whatever action will be necessary to bring about the exclusive use of meter-liter-gram by the United States."

D. P. Mackey, supreme commander of the Maccabees, Detroit, Mich. (February 24, 1921): "I favor the gradual adoption of the metric standards in the United States during a transition period of 10 years."

Arthur H. Blanchard, president American Road Builders' Assocation, New York City (May 2, 1919): "For many years I have heartily approved and strongly advocated the international standardization of weights and the adoption of the metric system."

Samuel Gompers, president American Federation of Labor (June 12, 1919): "I firmly believe and long have believed that the metric system offers a return to simplicity, offers an effectiveness of thought, offers much even to children in our schools which we are not justified in withholding from them. The metric system is winning its way entirely on its merits just as it should because it is easy to learn, to work with, and best suited for practical purposes."

John Wilkinson, president United Mine Workers of America, district 21, Fort Worth, Tex. (August 27, 1919): "I believe that the proposal of the World Trade Club of San Francisco is entirely logical, and should be put in operation by all nations. While in Great Britain, Lloyd George and I repeatedly discussed the meter-liter-gram system. This was about 10 or 11 years

ago. We discussed it then in the interest of the trade in the British Colonies and with uncivilized nations, and we realized that the natives could more easily comprehend a metric system than that system in vogue in Great Britain and that it did place Great Britain at a disadvantage with France and other nations who did employ the metric system. However, the proposed changes met a good deal of opposition owing to the fact that the money in Great Britain was largely metal currency and in fact very little paper money was used at that time; but since then, and during the period of the war, especially, Great Britain has resorted to paper currency to a much greater extent than was employed prior to the war, and I believe that the change to the meter-liter-gram system would be viewed with more favor, especially as a reconstruction measure, than it was viewed at the time I have mentioned."

C. S. Warner, secretary Brotherhood of Railroad Trainmen, Ogden, Utah (June 6, 1919): "I know of the advantages of the metric system, and have always regretted that it was not adopted in the country long ago."

A. Persion, general secretary-treasurer International Hod Carriers' Building and Common Laborers' Union of America, Quincy, Mass. (October 20, 1919): "I personally and officially concur in the campaign to have the meter-liter-gram system adopted in these United States and in the British Isles, being acquainted with both the metric system and the local system of measuring. Any practical mind will realize that to make calculations with the unit of measures now in use in this country and in Britannia requires an extra amount of work as compared with the simplicity of the metric system.

"Only a few days ago I ordered from our jeweler a gross of our society emblems, and on receiving the shipment we then counted 120 buttons, but we received a bill for a full gross. Making complaint to the manufacturer, he traced the error to his shipping clerk, who being also a graduate of high school had in mind that a gross was 10 dozen. Indeed, I don't blame the young student. In his mind he had an advanced idea of the metric system.

THOUSANDS OF ORGANIZATIONS USE METRIC STANDARDS.

There has already been presented in this chapter a survey of the overwhelming sentiment in favor of metric standards among important national organizations throughout the United States. Scarcely a national business association exists which has not interested itself in this subject. Besides the hundreds of national associations there are literally thousands of other organizations which urge the metric advance—interstate, State, county, city, and local. It would be impossible to review the published opinions of these societies within the scope of several volumes, but most of them have placed their statements in favor of metric standards on record at Washington, D. C., where they are available to our national legislators. Here we can merely present a few typical statements and give the names of some of the thousands of organizations which are working for meter-liter-gram in the United States of America.

Western Association of Electrical Inspectors, through William S. Boyd, secretary, Chicago, Ill.: "This organization indorses legislation that will bring about the exclusive use of the meter-liter-gram system of weights and measures by the United States of America and by the British Isles. This association has witnessed the good effect of the adoption of the watt as the basis of power, enabling the rating of electric apparatus in kilowatts."

Connecticut Hardware Association (February 11, 1920), by resolution: "As the metric system is very simple in its operation when once established, we would indorse its use in the United States of America as soon as it could be arranged."

California Retail Hardware and Implement Association, through J. Glenn Marks, secretary-treasurer, Los Angeles, Calif. (July 3, 1919): "Bully for the idea. Count us strongly in favor of the universal adoption of this standardization. It is one great step forward in our commercial world, and now is the time to replace our obsolete methods of measurement with a practical system."

Washington State Manufacturers' Association, Seattle, Wash. (November 6, 1919): "Referendum: Upon the authorization of the board of trustees, on June 25, a referendum was taken of our membership in which the manufacturers were asked to express themselves for or against the adoption of a metric system of weights and measures. Results: Substantial returns were made by the manufacturers, showing them to be 2 to 1 in favor of the adoption of the metric system. Publicity: The results of this referendum were canvassed by the board of trustees, and the secretary was instructed to advise the organizations at interest of the results. Replies: Since sending out our letter over the

country we have had a large number of favorable replies from various manufacturers and commercial organizations. By far the larger majority of these have either taken favorable action or are contemplating doing so. The last publication of the official organ, the Seattle Spirit, of the Seattle Chamber of Commerce, indicates favorable action by this organization."

The secretary of the Washington State Manufacturers' Association, Clancey M. Lewis, declared (April 29, 1920): "It does not occur to me that the metric standardization needs any argument. It is one of those axiomatic premises upon which all subsequent commercial relations are dependent." (See also ch. 7 for his address before the World Metric Standardization Conference, May 17, 1920.)

Nebraska Manufacturers' Association, Lincoln, Nebr., through Frank I. Ringer, commissioner (November 6, 1919): "At a recent meeting of our board of directors the meter-liter-gram was indorsed." (Metric petition sent to Congress.)

New York State Wholesale Grocers' Association, in convention in New York City, 1920:

"Whereas it is to be hoped that the promotion of closer relations among the nations is to be one of the beneficent results of peace; and

"Whereas we recognize the disadvantages of our present cumbersome tables of weights and measures: Therefore be it

"*Resolved*, That we urge manufacturers and our members to indicate on all labels the metric equivalents, in addition to the English weights and measures; and we commend our metric system committee for its excellent educational campaign, and we request it to continue the good work."

(This association consists of 126 of the largest wholesale grocery firms in the State of New York, doing a volume of business amounting to over $300,000,000 a year, and employing over 58,000 people; it has passed unanimous metric resolutions at its last eight conventions.)

Southern California Retail Lumber Dealers' Association has petitioned the President of the United States of America and the British Premier to use their offices in bringing about world metric standardization. F. L. Morgan, secretary-treasurer, Los Angeles, Calif., writes (April 22, 1919): "Almost any way that would bring about a change would be welcome."

Northern White Cedar Association, through N. E. Baucher, secretary (May 13, 1919): "The Northern White Cedar Association is a voluntary organization of firms engaged in the production and sale of northern white cedar and other allied forest products. Its membership comprises 40 firms located throughout the States of Minnesota, Wisconsin, Michigan, and Ontario. It is the firm belief of our governing board that the universal adoption of the metric system will prove beneficial to American and Canadian business, and we hereby indorse legislation that will bring about the exclusive use of the meter, liter, and gram by the British Commonwealths as well as by the United States of America."

Ohio Grand Council, United Commercial Travelers of America, in convention at Youngstown, Ohio (June 14, 1919), unanimously adopted resolutions urging meter-liter-gram, "and that the President of the United States and the British Premier be respectfully requested to use their efforts to bring about the exclusive use of the meter-liter-gram system by the United States and Great Britain."

Upper Peninsula Development Bureau, Michigan (June 2, 1919): "The Upper Peninsula Development Bureau of the State of Michigan is heartily in favor of the adoption by Great Britain and America of the metric system of weights and measures."

Home Industry League of California, San Francisco, Calif. (December 1, 1919): "The Home Industry League, by resolution at the monthly meeting of the board of directors, indorsed the metric system of weights and measures." (Now incorporated in the California Industries Association.)

Texas Midcoast Industrial Congress, Collegeport, Tex., through H. A. Clapp, secretary (February 8, 1920): "Our membership is almost to a man in favor of metric standardization. You do not need to put up any argument to me as to the value of the metric system, for I lived in Mexico 10 years and used it." (This association comprises industrial interests in 12 coast counties of Texas.)

Ohio Master Painters and Decorators at their convention in Cedar Point, 1920, adopted resolutions indorsing the adoption of the metric system of measurement in their business.

Maryland State Beekeepers' Association:

"*Resolved*, That the Maryland State Beekeepers' Association is heartily in favor of the universal adoption of the metric system as the world standard of measurement."

Illinois Chapter of the American Institute of Architects, through Henry K. Holsman, secretary, Chicago, Ill.: "I am much in favor of legislation that will bring about the exclusive use of the meter-liter-gram by the United States of America. Judging from many discussions during the past year, I may say that I believe that our profession would almost unanimously welcome such a change from the present system of weights and measures. It would be a very great savior of labor and an efficient eliminator of many errors and their wasteful consequences in the work of our profession."

New York State Nurses' Association, through Julia A. Littlefield, R. N., Albany, N. Y. (November 18, 1919): "The members of the New York State Nurses' Association at their recent meeting held in Brooklyn, N. Y., indorsed the recommendation of the World Trade Club to standardize the weights and measures of the world by adopting meter-liter-gram."

Iowa State Medical Society, in convention at Des Moines (May 14, 1920):

"*Resolved*, That the Iowa State Medical Society urge that through legislation or promulgation the units of the metric system of weights and measures be made the exclusive legal standards within the jurisdiction of the United States of America."

Pennsylvania Pharmaceutical Association (October 28, 1920):

"*Resolved*, That we emphatically approve the universal adoption of the metric system for all commercial transactions at as early a date as is practicable."

Louis Saalbach, secretary, Pittsburgh, Pa., writes: "We have repeatedly taken this stand at our annual meetings, and we sincerely hope that the continued active work in its behalf will speedily bring about the adoption of the only logical system of weights and measures ever conceived by the ingenuity of humankind."

New Orleans Association of Commerce, New Orleans, La., through A. E. Pradillo, secretary Foreign Trade Bureau (December 19, 1921): "The Foreign Trade Bureau has for several months endeavored to obtain an expression from its members regarding their attitude toward the adoption in this country of the metric system as the single standard for weights and measures. A special committee was appointed to make a thorough study of the subject and make recommendations. At a meeting of our metric-system committee held July 5, it was decided that it would be to the advantage and benefit of our foreign-trade interests to have the exclusive use of the metric system as provided in a bill introduced in the House of Representatives, Sixty-seventh Congress (H. R. 10). The following resolution was unanimously adopted: 'It is the opinion and recommendation of the members of the committee that it should be recommended to the association of commerce to declare itself in favor of the use of the metric system in the United States for the reason that by its universal adoption (1) saving in time will be had in all operations where figuring of weights and measures will enter; (2) because it will lighten the work of the scholars, as they will not have to memorize all the relations between the units of the English system, as the metric is a decimal system; (3) it will also increase saving of brains and energy of men and women that have to work in weights and measures, this meaning a saving of millions of dollars; (4) considering our foreign-trade development, the metric system will place the United States of America on equal footing with our foreign competitors.' In adopting the above resolution the committee is aware of the fact that there is a number of members of other departments of the association of commerce who are opposed to the metric system, but the committee is also aware that their opposition is caused by their unfamiliarity with the subject. The committee feels that it may be the wisdom of the board of directors of the association of commerce in considering its recommendation to obtain the views of other members not interested in foreign trade, and the committee places itself at the disposal of the board of directors to confer with any member or group of members opposed to the recommendation, in the belief that by an interchange of views on the matter those members opposing the system will secure enough information to permit them to express their opinion consciously.

"At its meeting of November 9, 1921, the board of directors of the New Orleans Association of Commerce took the following action: 'Moved by Mr. McMillan, seconded by Mr. Dietrich, and carried, that the principle of the metric system be approved, and that it should be put into operation when the time is opportune.' Accordingly the resolution was transmitted to our Representatives in Washington, and to other parties who in our opinion will cooperate in carrying out our wishes."

Denver Civic and Commercial Association, Denver, Colo.: "Acting upon a resolution adopted by the retail merchants' bureau, the board of directors of the civic and commercial association has approved the bill pending in Congress for adopting the metric system." (Denver, Colo., News, December 2, 1921.)

Boston Chamber of Commerce, Boston, Mass., in 1900 passed resolutions urging gradual metric standardization of weights and measures; and the secretary, Elwyn G. Preston, appeared before Congress in its favor.

Los Angeles Chamber of Commerce, Los Angeles, Calif. (December 1, 1919): "We approve the metric system and recommend that the Government adopt it as rapidly as possible."

Oakland Chamber of Commerce, Oakland, Calif. (October 27, 1919): "Indorsement of the metric system was given by unanimous vote of our directors."

San Diego Chamber of Commerce, San Diego, Calif. (December 12, 1919): "With reference to the meter-liter-gram proposition, we have taken a referendum of the members of this chamber of commerce, and the vote stood as follows: In favor, 119; opposed, 7." Many other important organizations have taken a similar referendum, and of the votes cast a considerable majority favored gradual metric standardization.

Bronx Board of Trade, New York City (November 20, 1919): "The Bronx Board of Trade desires to be placed on record in favor of the introduction of the metric system of weights and measures in the United States and Great Britain."

Easton Board of Trade, Easton, Pa. (April 23, 1920), passed this resolution unanimously:

"*Resolved*, That we respectfully urge that the metric system be adopted by the Congress of the United States of America and by the Parliament of Great Britain as the exclusive standards of weights and measures."

In February, 1921, a resolution was adopted in reference to the metric standards bill.

"Whereas this measure provides for the gradual institution of the decimal metric units of weights and measures as the exclusive standards in commercial transactions in the United States after a transition period of 10 years; and

"Whereas under this act manufacturers may use any weight or measure they elect in production; and

"Whereas the Board of Trade of Easton has previously indorsed the metric system: Now, therefore, be it

"*Resolved*, That we express our approval of the metric standards bill and urge its passage in the interest of business efficiency in our vast domestic trade and our growing foreign commerce."

Akron Chamber of Commerce, Akron, Ohio, through Vincent L. Stevens, secretary: "The board of directors of the Akron Chamber of Commerce, at a meeting held September 5, 1919, unanimously adopted a report from our national affairs committee recommending that the meter-liter-gram system be adopted as the standard of measurement of the United States of America."

Perth Amboy Chamber of Commerce, Perth Amboy, N. J. (November 8, 1919): "We have noticed in different periodicals and newspapers an agitation in favor of the meter-liter-gram system of weights and measures. We believe that the adoption of this would save a great deal of money and time by the few nations who do not have it. This is an indorsement for the adoption of those units by America and Great Britain, that we may better do our own work and compete with the rest of the countries in the world's business."

Key West Chamber of Commerce, Key West, Fla. (February 16, 1920): "We have notified the Chamber of Commerce of the United States of our indorsement of world metric standardization of weights and measures and requested our Representatives and Senators to do all in their power for same."

Webster-Dudley Chamber of Commerce, Webster, Mass. (November 20, 1919): "A committee appointed for the consideration of the adoption of meter-liter-gram strongly urge the adoption of this system, as follows: '1. It is the logical system because of its simplicity. 2. It is the most universal system in use at the present time, and if adopted by the United States and Great Britain it would become the universal system. 3. In view of any expectation that we have for the development of our export trade and it being necessary that all offerings be made on this basis, its adoption becomes absolutely necessary. As the system is found and taught from text-books now in use, it does not necessitate any sweeping change in methods of instruction; it merely requires that more emphasis be placed upon this system in preference to our present method.'"

Galveston Cotton Exchange and Board of Trade, through its president, I. H. empner, "indorses legislation that will bring about the exclusive use of meter-:er-gram by the United States of America." (Petition to Congress, September 1919.)

Greeley Chamber of Commerce, Greeley, Colo., through Elmore Petersen, ecretary (April 20, 1920): "Indorsement of the meter-liter-gram system was iven by unanimous vote of our directors."

Chamber of Commerce of Greenwich, Conn., through Ralph Morrow, executive secretary (February 28, 1920): "We are about to conduct a campaign of education here in behalf of the metric system."

Berkeley Chamber of Commerce, Berkeley, Calif., through Wells Drury, managing director (February 6, 1920): "At a meeting of the board of directors of the Berkeley Chamber of Commerce in regular session a resolution was adopted by unanimous vote indorsing and favoring national legislation for the adoption and speedy introduction of the metric system throughout the United States of America. We are convinced that wisdom and patriotic duty call for standardization of our weights and measures, to the end that our manufacturers and our world traders shall not be unnecessarily handicapped in competition with other nations. It is an offense against common sense and the laws of trade for our Government to place our producers and merchants at such ruinous disadvantage in the keen struggle for world commerce. We ought t give them a fair chance by supplying them with tools of equal efficiency. This can be done without any great inconvenience or expense by adoption of the metric system."

Bartlesville Chamber of Commerce, Bartlesville, Okla., through William A. Baylor, secretary (November 14, 1919): "As a body representing the commercial interests of our city, we are interested in bringing about the best and most convenient system of business throughout the world. It is the desire of our organization to indorse legislation that will bring about the exclusive use of meter-liter-gram by the United States of America."

Casper Chamber of Commerce, Casper, Wyo., through Charles B. Stafford, manager (March 29, 1921): "Our directors at their meeting of March 9, 1921, indorsed the metric standards bill now before Congress."

Dallas Commercial Club, Dallas, Oreg. (November 6, 1919): "This organization has gone on record as favoring the adoption of the metric system, and has so advised our Members in Congress and the President of the United States and the ruler of Great Britain, these being the only two countries not using the metric system." (Representing the Dallas Commercial Club as national councilor in the Chamber of Commerce of the United States is Hon. Charles L. McNary, Senator from Oregon.)

East Liverpool Chamber of Commerce, East Liverpool, Ohio (the pottery center of America), through W. I. Lewis, secretary (June 27, 1919): "This organization indorses the exclusive use of meter-liter-gram by the United States of America and by the British Isles."

Chamber of Commerce of Morgan City and Berwick, La. (Aug. 27, 1919): "We respectfully and unanimously urge that the units of the metric system be adopted by the Congress of the United States of America and the British Parliament as the exclusive legal standards of weights and measures." J. P. Hebert, treasurer, writes: "My interest has been centered in this matter for several years, therefore it is always a pleasure to advance its adoption." Will C. Harman, manager, writes: "A majority of the Senators and Congressmen of this State (Louisiana) have promised favorable consideration of the metric system."

Nogales Chamber of Commerce, Nogales, Ariz., through Gil Rankin, secretary: "It was voted that the Nogales Chamber of Commerce indorse the adoption of the metric system of weights and measures by the only countries not now using it. Nothing can give greater impetus to the development of trade with Mexico than American adoption of the metric system of weights and measures to correspond with Mexican usage. * * * Although I spent but a mite of time learning the metric tables compared with that (in school and since) memorizing our American system (?), I have to-day a far more comprehensive understanding of the metric. Yankee inclination to save time and effort should have brought about the adoption of the metric system decades ago."

Phoenix Chamber of Commerce, Phoenix Ariz., through Harry Welch, secretary (Oct. 30, 1919): "The board of directors have indorsed the metric system."

Tucson Chamber of Commerce, Tucson, Ariz., through O. S. McPherson (Jan. 5, 1921): "Indorsement of the metric standardization system on the part of

the United States Government was to-day approved by action of our board of directors."

Point Pleasant Chamber of Commerce, Point Pleasant, N. J., through W. D. Stanford, secretary (Mar. 17, 1920): "This chamber of commerce made a referendum of its members on the subject of metric standardization, and this resulted in a unanimous vote in favor of metrics."

Richmond Industrial Commission, Richmond, Calif., through Paul Edwards, development and publicity agent: "Resolutions in support of meter-liter-gram have been forwarded. Like all sensible organizations, the Richmond Industrial Commission is in favor of this movement. Individual members are also sending indorsements."

Trinidad-Las Animas Chamber of Commerce, Trinidad, Colo. (Feb. 3, 1920): "At a recent meeting of our board of directors the meter-liter-gram system was unanimously approved. It is the sentiment of this organization that this system is the solution of the problem of development of extensive world trade by the United States of America."

Tyrone Chamber of Commerce, Tyrone, Pa. (June 2, 1919): "The board of directors of the Tyrone Chamber of Commerce in regular meeting unanimously indorsed the proposal for establishment in this country of the metric system."

Warner Commercial Club, Warner, S. Dak. (May 8, 1919):

"*Resolved*, That we urge upon the Government of the United States of America and the United Kingdom of Great Britain and Ireland, the urgency and need of proper legislation to establish the metric system of weights and measures within their respective jurisdiction, with view of securing uniformity in the civilized world in this respect."

Waukesha Chamber of Commerce, Waukesha, Wis., through George E. Girling, secretary (Apr. 5, 1920): "We should be glad to see the metric system adopted and shall do what we can to assist in having it done. We realize, of course, that its adoption might cause some confusion at first, but that would rapidly wear away and in a couple of years people would be used to the metric system as they now are to our present unsystematic method of weights and measures."

Ottawa Chamber of Commerce, Ottawa., Ill. (Nov. 22, 1921), went on record strongly in favor of the Britten-Ladd metric bill (H. R. 10 and S. 2267).

Business Men's Club, Fort Smith, Ark., through Ray Gill, secretary: "At a joint meeting of the directors of the Business Men's Club and Merchants' Association, held September 9, 1920, the indorsement of the world standardization metric system was unanimously reaffirmed, the original indorsement having been made several months ago."

Gainesville Chamber of Commerce, Gainesville, Ga. (January 22, 1921):

"*Resolved*, That the Gainesville (Ga.) Chamber of Commerce unanimously indorses the world metric system and desires to go on record as being heartily in favor of the proposed plan for world standardization on the metric system."

Merchants and Manufacturers Association, Mount Vernon, N. Y., through M. B. MacCauley, secretary (January 21, 1921): "The board of directors of this association have unanimously passed a resolution favoring the metric standards bill."

Chamber of Commerce of Michigan City, Ind., through W. K. Greenebaum, secretary-manager (February 8, 1921): "The board of directors unanimously voted in favor of the gradual standardization of weights and measures and adoption in the United States of the metric system bill now before Congress."

Miami Chamber of Commerce, Miami, Fla., through Guy W. Livingston, managing secretary (September 14, 1920): "The matter was carefully considered at a meeting of the directors of the Miami Chamber of Commerce, and it was unanimously agreed to indorse the action of the International Chamber of Commerce and to give our most hearty approval of the adoption of the standard metric system for the United States of America."

Emporia Chamber of Commerce, Emporia, Kans., through J. M. Hilton, secretary (February 1, 1921): "This chamber of commerce is in favor of the metric standards bill now before Congress."

Illinois Valley Manufacturers Club, La Salle, Ill. (December 6, 1921):

"Whereas the United States of America and Great Britain (together with their dependencies and colonies) are the only ones among the 'great family of civilized nations,' which have not already adopted for exclusive use the metric system of weights and measures; and which still cling to the obsolete, confused, inaccurate, and misleading system, commonly known as the English system; and

"Whereas Great Britain is said to be on the point of adopting the metric system; and

"Whereas 43 other nations, consisting of about 200 countries (including colonies) have adopted, and are still using successfully, the meter-liter-gram or metric system, which may thus be considered as the international or universal or standard system of the world; and

"Whereas international standardization of weights and measures is essential to both domestic and foreign trade, and tends to promote friendly relations and commerce among the people of the world; and

"Whereas the Illinois Valley Manufacturers Club has already placed itself on record by a practically unanimous vote as being in favor of an early change to the metric system; and

"Whereas identical bills, S. 2267 and H. R. 10, have been prepared with great care so as to effect a gradual change and so prevent, as far as possible, confusion among our citizens, or expense and loss among our fellow manufacturers: Now, therefore, be it

"*Resolved*, That the board of directors of the Illinois Valley Manufacturers' Club hereby approves and indorses the provisions of the above-mentioned identical bills, S. 2267 and H. R. 10, as a just, wise, conservative, and constructive measure which will benefit, in an incalculable degree, all the people of the United States, and the manufacturers in particular: And be it further

"*Resolved*, That the members of the club and executives of the various factories are hereby requested to write individual letters to our Congressmen and Senators urging them to vote for the above-mentioned bills.

"*Resolved*, That copies of this resolution be forwarded to the Secretary of Commerce, the Director of the Bureau of Standards, Senator Ladd, Congressman Britten, and to each Senator and Congressman from the State of Illinois in the Congress of the United States."

The La Salle Chamber of Commerce also has passed strong resolutions of indorsement of gradual metric standardization.

Italian Chamber of Commerce in New York (April 19, 1920): "The Italian Chamber of Commerce in New York, an American association, organized and existing under the laws of the State of New York, begs to express its full, hearty, and unconditional approval of the bill which is soon to come up in Congress, proposing the adoption for the United States of the meter-liter-gram units of weight and measure."

Holland American Chamber of Commerce, San Francisco, Calif., through the secretary (May 7, 1920): "I beg to inform you that our chamber of commerce strongly recommends metric-standardization for the United States, and we shall be glad if you will mention this fact."

United Bureau of Statistics and Publication, Chicago, Ill., through Clyde A. Mann, manager (August 26, 1919): "We have found the metric pamphlets of the World Trade Club very interesting, and very near akin to an effort which has originated here for enforcement of honest weights and measures, for recognition of the aid to industry which has come from the Bureau of Standards, and for a reduction in the cost of living in another way than price. We are heartily in accord with the cause you are presenting."

City Retail Merchants' League, Jefferson City, Mo. (December 1, 1919): "The merchants' league, in convention assembled, voted unanimously to indorse any legislation that would bring about the exclusive use of the meter-liter-gram by the United States of America. We trust that action on this advance will come in the very near future."

Wilmington (Del.) Chapter, American Association of Engineers: "At its meeting of February 8, 1921, the Wilmington Chapter, American Association of Engineers, unanimously passed a motion favoring the adoption of the metric system in the United States of America."

Cement Contractors' Association, St. Louis, Mo., through R. W. Bruner, secretary (May 23, 1920): "We are heartily in favor of the early adoption of the metric system in this country."

Grocers and Importers' Exchange of Philadelphia, Philadelphia Bourse, through John E. Poore, secretary (March 9, 1921): "At a meeting of the board of directors of this exchange the committee on commerce, after due consideration, recommended that favorable action be taken on the gradual adoption of the metric system as a standard of weights and measures in the United States of America. Their recommendation was unanimously approved."

Pittsburgh Teachers' Association, Pittsburgh, Pa. (June 6, 1920), in general meeting advocated adoption of the metric system of weights and measures.

Previously the system was indorsed by the board of directors and by the legislative committee of the association.

Teachers' Association of San Francisco, Calif. (April 26, 1920): "Resolved that we, as teachers, approve of the efforts of the World Trade Club to gradually introduce the metric system into the United States of America."

Teachers' Union, City of New York, through Henry R. Linville, president: "The Teachers' Union, at a meeting held March 12, 1921, took action approving the Senate bill fixing the metric system of weights and measures as a single standard."

Mission Street Merchants' Association, San Francisco, Calif., through J. C. Marshall, secretary (October 16, 1920): "Our committee reported favorably on adoption of metric standardization of weights and measures and a resolution to that effect was unanimously adpted. Standardization of weights and measures is absolutely necessary and will be of tremendous benefit to the English-speaking race."

The Junior League of the City of New York, through Caramai Carroll, secretary (October 4, 1920): "We are much in sympathy with the work of the World Metric Standardization Council."

Tarrant County Humane Society, Fort Worth, Tex., through John M. Adams, general secretary and superintendent (November 29, 1920): "It has long been a paradox that the Government first establishing decimal coinage should have so long delayed in following it up with a decimal system of weights and measures."

Muskegon Society for the Prevention of Cruelty, Muskegon, Mich., through A. M. Wood, secretary: "The Muskegon Society for the Prevention of Cruelty is heartily in favor of the adoption of the metric standards of weight and measure in the United States of America."

Industrial Fellowship League, Flint, Mich.:

"*Resolved*, That we respectfully urge that the units of the metric system be adopted by the Congress of the United States of America and the British Parliament as the exclusive legal standards of weights and measures. Voted unanimously by the Industrial Fellowship League, a factory men's organization of Flint, Mich., May 11, 1920."

Rotary Club, Zanesville, Ohio (March 9, 1920): "The Zanesville Rotary Club has passed a resolution urging legislation that will bring about exclusive use of meter-liter-gram."

Rotary Club, Lawton, Okla. (March 14, 1920): "Our committee reported favorably on metric standardization, after which the club voted unanimously to indorse the same."

Rotary Club, Piqua, Ohio (February 21, 1920): "The board of directors Piqua Rotary Club went on record as favoring the metric standardization of weights and measures."

Rotary Club, San Antonio, Tex. (October 19, 1920): "The directors of this club indorse metric standardization. We are glad to note that the movement is making distinct progress."

Rotary Club, Chillicothe, Ohio (January 31, 1921), through A. R. Wolfe, president: The following was unanimously adopted by the Rotary Club of this city after careful discussion and consideration:

"Whereas, the experience of the recent war has further emphasized the very great need for world standardization of all weights and measures through the adoption of metric units; and

Whereas the present antiquated jumble of weights and measures now in use in the country is a hindrance to education, industry, world trade, and all activities of daily life, and has proved a handicap in the World War, and will handicap us in our future dealings with the other civilized nations of the world, the vast majority of which have now adopted metric standardization with the exception of the United States and the British Isles; and

Whereas, the metric system is simple, logical, and easy to use because it is a decimal system with only 3 units—the meter, liter, and gram: Now, therefore, be it

"*Resolved*, That the Rotary Club of the city of Chillicothe respectfully urges that the units of the metric system be adopted by the Congress of the United States of America and the British Parliament as the exclusive legal standards of weights and measures."

Clarendon Ions, secretary Kiwanis Club, San Antonio, Tex.: "Upon careful investigation and examination, I find the metric movement worthy of the most earnest consideration and believe it to be a step in the direction of Anglo-

American unity, the importance of which is becoming fully recognized by the constructive thinkers of both nations. May I urge for this movement the respect and consideration due action taken by level-headed business men, seeking to accomplish a practical constructive object."

Nicholas G. Vreeland, secretary Chamber of Commerce, Metuchen, N. J. (Aug. 25, 1919): "The metric system is, indeed, an important subject, and I hope to see official action taken in both England and the United States."

LaVerne R. Collier, adjutant, Department of Idaho, American Legion (Dec. 12, 1919): "Service men at large, I believe, will be glad to cooperate in endeavoring to obtain legislation for the institution of the metric system. I feel that service men who used the metric system for range finding and all measurements in France are all of the same opinion on these matters." (A great number of posts of the American Legion have gone on record urging the logical decimal system for the United States of America.)

James E. Sullivan, when secretary of the Amateur Athletic Union of the United States: "Wherever metric games have been tried in the United States their success has been pronounced and they have been satisfactory in every detail. It is not a matter of mere guesswork as to the merits of the metric athletic measurements. Everyone recalls the Olympic games at the St. Louis Exposition, held under the metric measurements. With the general use of the metric system in the sphere of athletics we could at last have uniform measurements and standards records—standard in the true sense of the word. Under the existing conflict of measurements it is well-nigh impossible to compare continental atheltic records with our own or England's. Even in the relation of this country to England, in spite of the fact that our athletic distances are practically the same, the use of the metric rules would be of benefit, in that they would smooth out one or two slight differences now apparent in the runs. I am a firm believer in the universal athletic good that could be accomplished by the general adoption of the system that, already tested, has not been found wanting. Not only in the runs and dashes but also in such events as the hammer throw and shot put would the measures be standardized."

James J. Duffy, when superintendent of the New York Athletic Club, declared: "The use of the metric system in athletics on the Continent of Europe has clearly demonstrated its value and superiority over the system we employ in America. I would like to see it used in the New York Athletic Club games."

The statements which have been given are typical of thousands issued in every part of the United States of America by influential organizations. Chambers of commerce, boards of trade, manufacturers' associations, agricultural associations, Rotary Clubs, Kiwanis Clubs, posts of the American Legion and other orders of veterans of the World War, posts of the Knights of Columbus, many labor organizations, organized women, associations of educators, scientists, physicians, surgeons, attorneys, packers, miners, growers, druggists, opticians, accountants, advertisers, organizations for the prevention of cruelty to animals (and to humans), leaders in the Young Men's Christian Association, in the Young Women's Christian Association, Hebrew Associations, missionary and church associations of all denominations, these and thousands of others are participating in the organized movement to secure the advantages of world metric standardization for the United States of America.

Was ever any movement so unanimous? Note the number of resolutions in favor of the logical metric system which were carried by unanimous vote.

SUPPLEMENTARY LIST OF COMMERCIAL ORGANIZATIONS IN THE UNITED STATES OF AMERICA URGING GRADUAL METRIC STANDARDIZATION.

Southern Commercial Congress.
Retail Merchants Association of Texas, Fort Worth, Tex.
Oregon State Retailers' Association, Portland, Oreg.
Retail Trade Bureau, Seattle, Wash.
International Association of Teachers of Printing (through Joseph A. Donnelly, president), New York City.
Young Men's Business League, Houston, Tex.
Rhode Island Business League, Greenville, R. I.
Mississippi Valley Association.
Pacific Coast Merchant Tailors' Association.
Grocers and Importers' Exchange of Philadelphia, Pa.
Italian Chamber of Commerce, San Francisco, Calif.
Belding Board of Commerce, Belding, Mich.

Yakima Commercial club, Yakima, Wash.
Santa Monica-Ocean Park Chamber of Commerce, Ocean Park, Calif.
Manufacturers' Club of Michigan City, Michigan City, Ind. (through Be Blocksom, president).
NOTE.—This list supplements the list already given in previous testimony.
Merchants and Manufacturers' Association, Mount Vernon, N. Y. (throu M. B. McCauley, secretary).
The Mexican Society of New York (Inc.) (through Francisco Juirez, pre dent).
Greater Muscatine Committee, Muscatine, Iowa (through Ralph D. Chambe lain, secretary.
Madison Community Club, Madison, Nebr.
Morgan City and Berwick Chamber of Commerce, Morgan City, La.
Chamber of Commerce of the County Seat of Nevada County, Calif.
Richmond Industrial Commission, Richmond, Calif.
Commercial Club of Warner, S. Dak.
Chamber of Commerce, Lakeland, Fla.
Chamber of Commerce, Chico, Calif.
Chamber of Commerce, Ukiah, Calif.
Chamber of Commerce, Colville, Wash.
Chamber of Commerce, Elizabethtown, Ill.
Chamber of Commerce, LaJolla, Calif.
Chamber of Commerce, Laredo, Tex.
Chamber of Commerce, Marshall, Tex.
Chamber of Commerce, Newport Beach, Calif.
Chamber of Commerce, Plattsburgh, Mo.
Chamber of Commerce, Redlands, Calif.
Chamber of Commerce, St. Helens, Oreg.
Chamber of Commerce, Swainsboro, Ga.
Chamber of Commerce, Venice, Calif.
Chamber of Commerce, Wellston, Mo.
Stanislaus County Board of Trade, Modesto, Calif.
Blue Earth Commercial Club, Blue Earth, Minn.
Board of Trade, Anaheim, Calif.
Board of Trade, Eustis, Fla.
Board of Trade, Toms River, N. J.
Commercial Club, Boise, Idaho.
Commercial Club, Canby, Minn.
Commercial Club, Cove, Oreg.
Commercial Club, Dickinson, N. Dak.
Commercial Club, Sauk Rapids, Minn.
Manufacturers' Association, South San Francisco, Calif.
Northside Business Club, Cincinnati, Ohio.
100% Club, San Francisco, Calif.
South Side Business Men's Association, Chicago, Ill.
Old Town Merchants and Manufacturers' Association, Baltimore, Md.
Young Men's Business Association, Nogales, Ariz.
Richmond Manufacturers' Association, Richmond, Calif.
Automobile Repairers of San Francisco, Calif.
Draymen's Association of San Francisco, Calif.
San Jacinto Growers' Association, San Jacinto, Calif.
Automobile Body Builders, Painters, and Trimmers' Association, San Fra cisco, Calif.
Swedish Society of San Francisco, Calif.
California Division, Travelers' Protective Association.
Traffic Efficiency Bureau, San Francisco, Calif.
Blue Ridge League of West Virginia, Waynesboro, Va.
Challenge Cream and Butter Association, Los Angeles, Calif.
Chestnut Street Association of Philadelphia, Pa.
Civitan Club, Birmingham, Ala.
Civic Betterment Union of Salt Lake City, Utah.
Clintonville Advancement Association, Clintonville, Wis.
Consumers' League of Ohio, Cleveland, Ohio.
Horicon Advancement Association, Horicon, Wis.
Kansas Retail Butchers' Association, Osage City, Kans.
Lawndale and Communities Improvement Association, Lawndale, Calif.
Japanese Chamber of Commerce, San Francisco, Calif.

Columbia Commercial Club. Columbia, Mo.
Little Rock Cotton Exchange, Little Rock, Ark.
Little Rock Grain Exchange, Little Rock, Ark.
Merchants and Manufacturers' Association, Redlands, Calif.
Ohio Automobile Trade Association, Columbus, Ohio.
Ohio Valley Retail Shoe Dealers' Association, Cincinnati, Ohio.
Oklahoma Utilities Association.
Oregon State Hotel Association, Portland, Oreg.
Retail Confectioners' Association of Oregon, Portland, Oreg.
Viroqua Advancement Association, Viroqua, Wis.
Wholesale Fruit and Produce Merchants' Credit Association, San Francisco, Calif.
Wholesale Shoe League, New York City.
Cement Contractors' Association, St. Louis, Mo.
Bakers' Mutual Cooperative Association, Newark, N. J.

SUPPLEMENTARY LIST TYPICAL OF THE THOUSANDS OF ORGANIZATIONS THROUGHOUT THE UNITED STATES OF AMERICA URGING GRADUAL METRIC STANDARDIZATION OF WEIGHTS AND MEASURES.

American Institute of the City of New York.
Aero Club of Detroit, Mich.
Alumni Association, University of Florida.
Philadelphia Rifle Club (through Albert T. Amann, secretary).
American Federation of Human Rights (through W. L. Krotona-Ragoczi, Hollywood, Calif.
Wagner Free Institute of Science, Philadelphia, Pa.
Warren County Medical Society, Warren, Pa.
American Legion, Virginia Department, Richmond, Va.
Brotherhood of Railroad Trainmen, Lodge No. 68, Ogden, Utah.
California Badger Club, Los Angeles, Calif.
Chemistry Club of Grinnell College.
Chicago Committee of French Red Cross.
Chicago Norske Klub, Chicago, Ill.
Composition Roofers' Union, No. 21, Los Angeles, Calif.
Cotton Plant Automobile Club, Cotton Plant, Ark.
East End Council, 247, Royal Arcanum, Pittsburgh, Pa.
East Tacoma Encampment, No. 53, I. O. O. F., Tacoma, Wash.
Engineers' Club, Minneapolis, Minn.
Engineers' Club of Philadelphia.
Entiat Fruit Growers' League, Entiat, Wash.
Equitable Life Assurance Society of New York.
Esperanto Office of Detroit, Mich.
Federated Alumni of the University of Buffalo.
General Fertilizer Association, San Bernardino, Calif.
Harmony Lodge, No. 13, I. O. O. F., San Francisco, Calif.
Independent Order of Puritans, Pittsburgh, Pa.
Indiana Retail Jewelers' Association, Auburn, Ind.
Indiana State Conference Board of the International Molders' Union of rth America.
International Association of Machinists, Lodge No. 303, Rochester, N. Y.
Eastern Lodge, No. 387, I. O. O. F., Detroit, Mich.
Florida Lodge, No. 1, I. O. O. F., Jacksonville, Fla.
Golden Link Lodge, No. 167, I. O. O. F., Minneapolis, Minn.
International Order of Good Templars, Kampen Lodge, No. 15, Worcester, ss.
Keokuk Council, No. 400, United Commercial Travelers of America.
Kiwanis Club, Albuquerque, N. Mex.
Kiwanis Club, Battle Creek, Mich.
Jonathan Wood Lodge, No. 30, Knights of Pythias, Memphis, Tenn.
Liberty Lodge, No. 18, Knights of Pythias, St. Louis, Mo.
Mount William Lodge, No. 105, Knights of Pythias.
Nicollet Lodge, No. 46, Knights of Pythias, Minneapolis, Minn.
Unity Lodge, No. 4, Knights of Pythias, Minneapolis, Minn.
Unity Lodge, No. 61, Knights of Pythias, San Francisco, Calif.
Lincoln Central Labor Union, Lincoln, Nebr.
Los Angeles Motor Boat Club, Los Angeles Harbor, Calif.

Milwaukee Engineering Society, Milwaukee, Wis.
The Modern Samaritans, Hiawatha Council, No. 25, M. S., Minneapolis, Min
Montana Lodge, No. 13, Knights of Pythias, Anaconda, Mont.
Musicians Union, No. 6, American Federation of Musicians, San Francisc Calif.
Branch No. 195, National Association of Letter Carriers, St. Joseph, Mo.
Muskegon Teachers' Club, Muskegon, Mich.
National Council, The Knights and Ladies of Security, Pacific Council, No. 45 St. Joseph, Mo.
National Social Unit Organization, Cincinnati, Ohio.
New Hampshire Federation of Women's Clubs, Concord, N. H.
New York County Registered Nurses' Association, New Rochelle, N. Y.
North Pacific Conference of Optometry.
Northern Ohio Druggists' Association, Cleveland, Ohio.
Pennsylvania Numismatic Society.
Priest River National Farm Loan Association, Priest River, Idaho.
Salt Lake County Chiropractors' Association, Salt Lake City, Utah.
Scandia Cooperative Association, Escanaba, Mich.
Seventh Ward Improvement Association, New Orleans, La.
Snoqualmie Tribe, No. 5, Imp. O. R. M., Tacoma, Wash.
Society of Arts and Crafts, Detroit, Mich.
Sons of Norway, Dovre Lodge, No. 3, Minneapolis, Minn.
South Gate Lodge, No. 320, F. & A. M., Los Angeles, Calif.
Lodge Gustav V., No. 175, Vasa Order of America, San Diego, Calif.
West Side Fruit Growers' Association, Cupertino, Calif.
Western Pennsylvania Numismatic Society.
Winona Teachers' Federation, Winona, Minn.
Yakima Fruit Growers' Association, Yakima, Wash.
York County Medical Society, York, Pa.
Caledonian Club of San Francisco, Calif.
Colorado State Society, San Diego, Calif.
California Division, Travelers Protective Association.
Sutro Heights Improvement Clulb, San Francisco, Calif.
Pacific Coast Numismatic Society.
San Francisco Camp No. 4, National Indian War Veterans, San Franc Calif.
California Chapter, American Chemical Society.
California Alpha of Tau Beta Phi (national engineering honor society).
San Francisco Chapter, American Institute of Architects.
Willow Hill Lodge, No. 884, I. O. O. F., Willow Hill, Ill.
Duquesne Council, Knights of Columbus, No. 264, Pittsburgh, Pa.
Napa Lodge, B. P. O. E., Napa, Calif.
Lancaster County Medical Society, Nebr.
Kings County (N. Y.) Department, American Legion.
Lehigh Valley Metric Association, Easton, Pa.
Ida County Medical Society, Battle Creek, Iowa.
City Playground League of New York.
Hidalgo County Medical Society, McAllen, Tex.
Fortnightly Club of Grand Forks, N. Dak.
St. Louis Chemical Society, St. Louis, Mo.
New York State Science Teachers' Association.
New York State Associated Academy Principals.
New York State Training School Teachers' Association.
New York Drawing Teachers' Club.
New York State Teachers' Association.
Dental Society of the District of Columbia.
Woman's Club, Stuart, Fla. (110 members).
New York Academy of Sciences (vote taken May 13, 1920, showed more th 90 per cent of members favor exclusive use of metric units).
Society of American Wars, Commandery of State of New York.
Brooklyn Federation of Jewish Charities, Brooklyn, N. Y. (through Max Al man, secretary).
Torrey Botanical Club, New York City.
Executive Committee Architectural League of New York.
Louisiana State Medical Society, New Orleans, La.
Medical Society of the State of Pennsylvania.
Iowa State Medical Society, Des Moines, Iowa.

New Mexico Electrical Association.
Montana Society of Certified Public Accountants, Helena, Mont.
North Dakota Society of Engineers, Bismarck, N. Dak.
Minnesota Horse Breeders' Association, St. Paul, Minn.
American Legion, Department of New York (through Hugh W. Robertson, New York City).
Kings County Department, American Legion, Brooklyn, N. Y.
Colonel William Jay Schieffelin, president Citizens' Union of New York City.
Lodge 1224, B. P. O. E., St. Petersburg, Fla.
Chinese Student Christian Association in North America.
Chinese Students' Alliance in the United States of America.
Women Lawyers' Association (National).
Logan County Medical Society, Lincoln, Ill.
I. O. O. F., No. 67, Fort Meade, Fla.
Wichita County Dental Society, Wichita Falls, Tex.
Divide Tonopah Chamber of Mines, Tonopah, Nev.

It is not only within the borders of the United States that Americans have been working for meter-liter-gram. As has been indicated, our interests are bound up in numerous world organizations, and these have taken action with great unanimity in behalf of the metric system. In closing this chapter, it is well to indicate world opinion as revealed in the declarations of these organizations:

International Chamber of Commerce (1920):

"Whereas the International Chamber of Commerce has adopted as its first principle a policy of hearty world cooperation; and

"Whereas there does exist at the present time a bewildering confusion in the weights and measures of the allied nations; and

"Whereas this confusion and waste during the world war was an element of serious inconvenience and in time of peace acts and an obstacle to efficient world cooperation; now, therefore, be it

"*Resolved*, That the board of directors of the International Chamber of Commerce recommend that in the whole world an uniformity of weights and measures be used, in order to facilitate international commerce."

At the organization meeting of the International Chamber of Commerce, Paris, June, 1920, the following was adopted by the United States of America Standardization Committee, and also by the group on production:

"*Resolved*, That the International Chamber of Commerce, in meeting duly assembled, urges world uniformity of weights and measures as a means of facilitating commerce through coordination, standardization, and simplification; and further, that the British Empire and the United States of America forthwith standardize on the metric system solely." (Referred to the board of directors.)

International Red Cross, through the secretariat, Geneva, Switzerland: "The International Red Cross Committee, which watches with the most careful attention any endeavor to foster international order, can not but applaud the campaign undertaken to unify weights and measures."

First International Conference of American States, Washington, D. C. (1889–1890):

"*Resolved*, That the International American Conference recommends the adoption of the metrical decimal system to the nations which have not already adopted it."

(See report of committee in Senate metric hearings, 1921, pt. 2, pp. 127–129.)

Fourth International Conference, held at Buenos Aires, 1910, recommended "the rigorous observance of the decimal metric system, so as to procure a possible uniformity in all that relates to weights and measures."

United States Section, Inter-American High Commission: At the 1918 session it was resolved "that the best interests of the country will be served by the passage of the metric standards bill." Resolution adopted on October 7, 1918: "The United States section of the International High Commission, having in view the present efforts to bring about the exclusive use of the metric system of weights and measures within the jurisdiction of the United States, resolves: That in the opinion of the section the adoption of the system would be productive of great advantage in the commercial relations of the United States with the other American Republics." (See testimony of Constantine E. McGuire, of the Inter-American High Commission, before Senate metric committee, 1921.)

Pan American Financial Conference, 1920:

"*Resolved*, That the conference recommends that the metric system of weights and measures be universally employed, and that pending the attainment of

that end, articles weighed and marked and shipping documents prepared according to the system of weights and measures now prevailing in the United States should be accompanied with statements giving the equivalents under the metric system."

Pan American Federation of Labor, through Canuto A. Vargas, secretary (May 21, 1920): "The metric system is the standard throughout Latin America and its adoption in the United States as the standard would greatly facilitate the trade with all of the peoples to the south of the Rio Grande."

Pan American Union: "Every issue of the Bulletin of the Pan American Union in all three editions—English, Spanish, and Portuguese—in all Latin American matters touching measures—whether commercial statistics, railways, industrial development, or other—uses metrics to the exclusion of all other measures. Especially in commercial statistics, almost every page and line of our publications emphasizes the metric dominance in those countries. Frequently we convert United States statistical reports into metric units and nomenclature. From time to time we have published special aricles in the metric situation."

International Metallurgical and Chemical Society, through the secretary, Billings, Mont., United States of America (April 3, 1920): "This organization has solidly supported and urged the universal adoption of the metric system of standardization."

International Geneva Association of Hotel and Restaurant Employees, with headquarters at 143 West Forty-fourth Street, New York City:

"*Resolved*, That the International Geneva Association of Hotel and Restaurant Employees, with branches (360) all over the world and with a membership of over 22,000, fully indorses and favors metric standardization of weights and measures in the United States of America, British Isles, and Canada." It was further resolved that this resolution, passed unanimously by the board of administration, be spread upon the minutes and published in the association's official organ, The Hotel Industry.

The Chamber of Commerce of the United States held an international trade conference at Atlantic City from October 20–24, 1919, in order that representatives of Britannia, France, Italy, and Belguim might lay before the business men of the United States of America the commercial needs and aspirations of their respective nations. The following request was presented to the resolution committee: "The undersigned foreign missions to the international trade conference at Atlantic City, October 20–24, 1919, respectfully request the Chamber of Commerce of the United States of America that in the Daily Bulletin of the International Trade Conference, in all printed reports of the conference, and in the report of the proceedings of the conference which will be printed in The Nation's Business all nonmetric weights and measures be followed by their equivalent in the international metric system." This request was signed for the Belgian mission by M. Albert E. Janssen, director, National Bank, Belgium, professor of University of Louvain; for the British mission by Hon. J. G. Jenkins, member of finance, London Chamber of Commerce, and Bailie John King, chairman National Light Castings Association, Glasgow; for the French mission by M. Tirman, councillor of state, representative of French Ministry of Commerce; and for the Italian mission by Commander Dr. Luigi Luiggi, member of the State Council of Public Works, professor at the University of Rome, and Commander Prof. Vittoria Meneghelli, president Chamber of Commerce of Venice.

International Sunshine Society, through Mrs. John Alden, president general, 96 Fifth Avenue, New York City (Feb. 28, 1920): "Our society will do everything possible to help in the cause of world metric standardization."

International Association of Rotary Clubs, through its official organ, The Rotarian, October, 1919: "The cumbersome system of weights and measures in use by the British Empire and the United States had its origin in Germany. The war with Germany forced these countries to abandon that system in military affairs, for the simpler and more scientific metric system. Germany has abandoned the old system and adopted the metric system in 1871, not only in military affairs but in all affairs. How much of Germany's success in gaining world trade was due to her use of a system of weights and measures uniform with the systems used by the countries where she sought trade? How much will Britannia and America be handicapped by retaining the old system forced upon England hundreds of years ago by the old German Hanseatic League?" (See typical resolutions by Rotary Clubs urging metric standardization, earlier in this chapter.)

International 100 Per Cent Club, representing substantial business interests in the United States and Canada, at its annual convention in Seattle, Wash., September, 1921, unanimously passed a resolution in favor of metric standardization. concluding thus:

"Whereas the International 100 Per Cent Club, by reason of the broad commercial and industrial interests of its membership, and particularly because of its international character, is vitally interested in the speedy adoption of world-wide uniform standards of weights and measures: Now therefore be it

"*Resolved*, That the International 100 Per Cent Club respectfully urges that the units of the metric system be adopted by the Congress of the United States as the legal standards of weights and measures after a transition period of 10 years, as proposed in bills now before the Senate and House of Representatives."

Chamber of Commerce of the Philippines, Manila, P. I. (May 20, 1920): "We join in the important campaign in favor of the establishment of the decimal metric system in the English-speaking countries. We believe, in fact, that the accomplishment of this project is indeed a necessity. Modern commercial intercourse needs standardization of weights and measures throughout the world, and this unity can be brought about no more simply than through the metric system. North America and the British Isles, being at the commercial head of the world, should be the most interested in seeing this system adopted."

Chamber of Commerce of the United States of America in the Argentine Republic, Buenos Aires, Argentina (Mar. 22, 1920): "The Chamber of Commerce of the United States of America in the Argentine Republic considers that no one single measure would so redound to the facilitating of the exchange of products and commodities between the Argentine Republic and the United States of America as the adoption by this latter country of the metric system."

American Chamber of Commerce in Spain, through the president, Barcelona, Spain (Mar. 16, 1920): "The desirability, and I may say the necessity, of American manufacturers and export merchants adopting the metric system is not a debatable question as far as our members are concerned. I am pleased to inform you therefore that this chamber and all of its members are unanimously in favor of such action." (Request a referendum of the Chamber of Commerce of the United States.)

American Chamber of Commerce in Belgium, Brussels, Belgium (Mar. 30, 1920):

"*Be it resolved*, That the American Belgian Chamber of Commerce in Belgium hereby appeals to the Government of the United States urging the prompt adoption of the metric system, and that it heartily indorses the movement already well in hand in the United States of America amongst trade communities toward this end."

American Association of Trade and Commerce, Berlin, Germany (February, 1920): "The cry now going forth from the commercial press in America for the universal adoption of the metric system of weights and measures is heartily supported by this chamber of commerce. It constitutes the first step toward reducing the dead load of international commerce and trade."

American Chamber of Commerce for Italy, through O. M. Smart, secretary, Milan (November 13, 1919): "The desirability of using the metric system is axiomatic in all foreign trade. Therefore, we are writing the Chamber of Commerce of the United States urging the adoption of this system."

American Chamber of Commerce for the Levant, through L. S. Moore, executive secretary, Constantinople (April 7, 1921): "The metric system is in universal use in the Levant and extension of its use rather than diminution may be anticipated for the future. Doubtless the United States of America will come to the realization of what seems logical in the system of measurements." (This organization was established in 1911 to extend American trade in the Near East; publishes Levantine Trade Review.)

American Chamber of Commerce of Tampico, Mexico, through Erby E. Swift, general manager (April 9, 1920): "Nothing could be done that would be of more benefit to the foreign trade of the United States than the adoption of the metric system. We American business men in Mexico realize it more than our brother business men at home. We wish to state that there is no greater detriment to the furthering of trade between the two countries than the fact that the United States does not use the metric system. It causes unending error and work. This chamber of commerce, with a membership of more than 400, approves of the effort to establish the metric system in the United States of America."

Among the other American commercial organizations abroad which have indorsed world metric standardization are the American Chamber of Commerce of Italy, Naples, Italy; American Chamber of Commerce for Brazil, Rio de Janeiro; and many others. What better testimony of the worth of metric units in actual practice? These organizations are made up of American business men, trained observers, who are right on the ground and who unqualifiedly declare the world metric standards successful in everyday use and far preferable to our antiquated jumble of weights and measures, which most of the enlightened nations scrapped long ago.

The organized business men of other countries are alive to the importance of the English-speaking peoples taking up the world units. Scores of chambers of commerce abroad have communicated with the World Metric Standardization Council, and have made their sentiment for world uniformity known through the International Chamber of Commerce. A number of letters may be cited as typical of the trend of world thought in organized business:

Chamber of Commerce of Bordeaux, France: "Relative to the general adoption in the English-speaking countries of the decimal metric system of weights and measures, we are very firmly convinced of the advantages that would come from the closer relationship brought about by the adoption of this system. We have therefore voiced an opinion unanimously in favor of the adoption of the plan."

Chamber of Commerce of Blois, France, through the president, Albert Poulain, officer of the Legion of Honor (July 15, 1919): "In regard to the general adoption of the metric system of weights and measures by all the allied powers, I have the pleasure to say that my organization has already several times expressed itself as believing that this unification ought to be made world-wide. Petitions are addressed to Mr. David Lloyd-George at London and to President Wilson at Washington."

Association of Commerce and Industry, La Chaux-de-Fonds, France: "We consider it our duty to aid in the campaign for the introduction of the metric system in the British Isles and the United States of America, for we know how greatly the introduction of this system would facilitate commercial transactions."

Chamber of Commerce of Rouen, France: "Under date of July 17, 1917, the Chamber of Commerce of Rouen went on record as believing that the decimal metric system ought to be adopted by all the allied powers in order to facilitate friendly commercial relations after the World War. This vote has been sent to the proper authorities."

Chamber of Commerce of Beziers, France: "Our chamber of commerce has long been interested in this question of the adoption of the metric system in the English-speaking countries, a question which we consider very important. We took a vote on this matter at our meeting of July 5, 1917, passing the following resolution: 'Voted that, the French Government petition the British Government requesting that every possible step be taken to institute and spread throughout all the territories under British jurisdiction the decimal metric system of weights, measures, and moneys, already used by practically every nation.'"

At this meeting of the Chamber of Commerce of Beziers important points were brought out: "If after the victory in the World War the Allies wish to win economic prosperity also, they will be obliged to join together in a commercial way as closely as they are to-day on the field of battle. This will not be possible unless there be a certain degree of broadminedness and a disposition to make concessions one to the other in matters of custom and taste. It is very difficult to carry on commerce between peoples who do not employ the same weights, the same measures, and the same system of money. A close union of the Allies, such as has been referred to, would not be complete unless they had this uniformity. * * * Have we not the right to ask the English-speaking people to make this slight sacrifice of tradition—we French, who have also great pride in our traditions? Have we not abandoned our meridian of Paris, for us a glorious memory, and our 'Huere Nationale,' in order to regulate our time in accordance with the Greenwich meridian? This sentiment of reciprocity should be added to the many practical advantages of the metric system as reason for the advance. The English-speaking peoples, eminently practical, will see that they have an interest like all the rest of the world in making the metric system universal. At the hour when England, France, and America are mingling their blood on the field of battle in the cause of civilization, that

moment seems well chosen for lowering the barrier which is caused by a diversity in weights and measures and money."

National Society for the Encouragement of Industry, Paris, France, through A. G. Lemaire, general agent: "We indorse the metric campaign, and have sent petitions to the President of the United States of America and the British Premier requesting the adoption of the metric units for exclusive use as legal standards in their respective countries."

Society of Civil Engineers of France: A communication from the Societé des Ingenieurs Civils de France, containing the following resolution of its council, was presented to the board of directors of the American Institute of Mining Engineers and ordered printed in its official magazine, Mining and Metallurgy, May, 1920: "The Societé des Ingenieurs Civils de France, in sending fraternal greeting to the American Institute of Mining Engineers, desires to draw the attention of its council of direction and of its members to the immense advantages which would result from the obligatory adoption of the metric system by the great American Union.

"If the Societé des Ingenieurs Civils de France feels that it ought to take this initiative now, it is because it has been informed of the existence in America of activities calculated to mislead public opinion and which, if successful, would result in depriving their American colleagues of that of which they themselves realize the value every day.

"It is also because in the year 1903, during which similar activities originating from the same source had already been noted, the American Chamber of Commerce of Paris had applied in full confidence to the Societé des Ingenieurs Civils de France for information placing it in condition to know the truth."

Chamber of Commerce of Liege, Belgium, July 1, 1920: "The Chamber of Commerce of Liege entirely favors world use of the metric units. The experience of Belgium, which has used the metric system now for a century and a quarter, has shown the excellence of this unified system of weights and measures. The opposition from certain people who before habitually criticized the step has long since stopped.

"It ought to be the same in Britain and the United States of America. One asks even now how these two great countries resist joining in using a system which for many years has worked so well in all the other countries of the world."

Central Normalistic Bureau (main committee for standardization in the Netherlands), Delft, Netherlands, through E. Nymans (November 13, 1919): "On the day that America will sacrifice the antiquated system of measures considerable loss of material, brainwork, and time will be saved not only for its own industry but also for that of all countries that are in commercial relation with the United States of America."

Agricultural Society of Colombia, Bogota, Colombia (March, 1920): "The firm and special desire of Colombia is to keep to the metric system and to avoid any mixture and complications with other systems."

Hundreds of associations throughout the world have participated in the organized effort to secure world uniformity of weights and measures. Besides those already cited, mention may be made of the Chambers of Commerce of Paris, Bourges, Cette, and Nimes, in France; Bruges and Ostend, in Belgium; Dordrecht and Hengelo, in the Netherlands; Catania, in Italy; Nakatan, in Japan; the Royal Society of Engineers in the Netherlands, and so on. The Society of Ladies, Kalamata, Greece, aided powerfully in securing metric standardization for Greece, 1920, translating the metric letters of the World Trade Club for distribution throughout that country.

The organized metric movement in the United States of America has been surveyed in the present chapter, together with an indication of the world-wide trend toward the unification of measures everywhere. In this great progressive movement Americans have taken a leading part, and it is trusted that the testimony here presented shows conclusively that organized business in the United States of America is virtually unanimous in favor of the metric system of weights and measures. And organized effort to secure this great advance has come not alone from the commercial community but from associations interested in every phase of human life. The nation-wide and world-wide demand for metric standardization can not be denied. Truly, the metric system is soon to achieve its "manifest destiny."

METRIC LEGISLATION BEFORE CONGRESS.

To-day the subject of metric standardization is prominently before both Houses of the Congress of the United States of America. More than 103,000 petitions have been sent to the national legislative body, urging this advance to the world system of weights and measures. States with a total population of 14,000,000 have through their legislatures memorialized Congress to take prompt action. As has been seen, thousands of powerful organizations are impressing upon Congress their firm conviction that it would be disastrous for the United States of America longer to lag behind. All elements in our population are urging the advance—and Congress is responsive. The enactment of metric legislation, putting the metric units into exclusive use in merchandising appears assured.

It will be of value to review briefly the history of metric legislation before Congress. For years the subject of world standardization has had the attention of thoughtful minds in our National Government, and many of our most eminent statesmen have urged it; yet at the crucial epochs they found themselves blocked by perverse forces of prejudice, habit, and inertia—and, since 1871, hindered by insidious propaganda which has sought to keep the United States of America chained to a cumbersome, antiquated jumble of weights and measures.

GEORGE WASHINGTON URGED STANDARDIZATION.

The Constitution of the United States gives to Congress the authority to fix and establish weights and measures—one of the few rights thus granted of which Congress has not yet taken full cognizance. George Washington, in his message to the First United States Congress, January 8, 1790, declared: "A uniformity of weights and measures is among the important objects submitted to you by the Constitution and if it can be derived from a standard at once invariable and universal, it must be no less honorable to the public council than conducive to the public convenience." Congress did not thus honor itself by adopting world metric standardization, but it at least led the way in another advance whereby it proclaimed the superiority of the decimal system, on which the metric system is based.

At about the same time that James Watt was evolving the decimally related system of weights and measures a number of progressive Americans were working out a decimal money system—one of the first outside the Orient.

JEFFERSON AND THE DECIMAL SYSTEM.

In his Life of Thomas Jefferson, James Schouler writes: "Jefferson's reentrance into Congress (November, 1783) was fortunate in bringing about the establishment of our coinage system—the most perfect, it is no exaggeration to say, that the world ever experienced. The happy idea of applying the decimal notation of money, in place of the arbitrary pounds, shillings, and pence to which we had been habituated as British subjects and which we could not easily dismiss, originated two years earlier with Gouverneur Morris, who was assisting his celebrated namesake, Robert Morris, in the supervising of continental finances. His able report to Congress, though sound in the main, proposed in the penny a unit too minute and impracticable for ordinary use; but as a member of the committee to which the subject was referred in 1784, Jefferson rescued the leading idea from its false excrescence by proposing the dollar as the true unit, with its decimal divisions and subdivisions down to the copper one-hundredth or cent, and with its further multiple of a $10 gold piece. Jefferson and Morris discussed their several views in print, and after a postponement the committee agreed to report the plan of the former, and it was adopted the next year. To Morris, therefore, belongs the honor of proposing the decimal system; while Jefferson gains rightfully a new claim, which he never made, to popularity as father of the American dollar. Jefferson stood all his life for a still broader reform against the stolid force of British habits; he wished the decimal system applied to all the weights and measures as well as to money. Congress has express power, under our present Constitution, to regulate this subject as well as the other; and some day, when a new statesman leads American opinion who can educate, this change will come about, and the wonder will then be that it did not come earlier."[1]

---

[1] See Thomas Jefferson, by James Schouler, New York; Dodd, Mead & Co., 1919. Pp. 127–128. Also copious references in published correspondence of Jefferson, and citations in this volume.

STATESMEN FAVORED LOGICAL UNITS.

If Thomas Jefferson had drawn up a declaration of independence against the tyranny of the obsolete jumble of weights and measures inherited from Great Britain, he would have had the signatures of George Washington, Benjamin Franklin, Alexander Hamilton, John Adams, Gouverneur Morris, James Madison, and other founders of the Republic, for they all worked to that end. Repeatedly this matter was drawn to the attention of Congress, and it was only because of the mass of details attendant upon launching the new Government that more progress in uniformity of weights and measures was not secured.

France, at the instance of Talleyrand, called a conference of European nations to discuss the establishment of a world system of weights and measures. Britain was invited to be represented, but the wrong-headed German King that sat on the British throne (the same that had estranged the American Colonies) obstinately refused to participate; and the British people have suffered infinitely through all the years because of this willful isolation. The United States of America, then but a youth amongst the nations, was not invited to be a participant in the world conference out of which the metric system grew. Had it been, undoubtedly we should have secured metric standardization from the outset just as France did, with the further advantage that we already possessed decimal coinage. At any rate, the English-speaking peoples sat at a distance and watched the conference adapting the idea worked out by one of their own race, James Watt, and setting up therefrom the perfected metric decimal system, of which they refused to avail themselves. Well might it be asked, "What if we, not using them ourselves, had let Watt's other great inventions thus slip to other peoples?"

The year that France adopted the metric system, 1799, the United States of America was engaged in a "quasiwar" with France, and that no doubt exerted a deterring effect in keeping us from enjoying the benefits of mertic standardization from the beginning.

JAMES MADISON PLEADS FOR METRICS.

Yet Americans were observant of the advantages of the world system of weights and measures, thus ingeniously worked out. Congress discussed the matter, and in his annual message of 1816, President James Madison wrote: "Congress will call to mind that no adequate provision has yet been made for the uniformity of weights and measures, also contemplated by the Constitution. The great utility of a standard fixed in nature, and founded on the easy rule of decimal proportions, is sufficiently obvious. It led the Government at an early stage to preparatory steps for introducing it; and a completion of the work will be a just title to the public gratitude."

Unfortunately, the work was not completed. All the turmoil of the Napoleonic wars had thrown the world into confusion, and France had not yet had sufficient opportunity to demonstrate the great practical utility of the metric system. John Quincy Adams, when Secretary of State, 1821, reviewed the subject in his Report on Weights and Measures, and while he could not fully appreciate the rapidity with which the metric system would come into practical use through its merits (at that time only one nation used it), he recognized the soundness of the plan and foresaw world metric standardization. "The meter will surround the globe," he prophesied, "in use as well as in multiplied extension, and one language of weights and measures will be spoken from the Equator to the poles."

In 1847–48 the United States Secretary of the Treasury and the Superintendent of Weights and Measures urged world uniformity on the basis of the decimal system; and Salmon P. Chase, Secretary of the Treasury, in his annual report of 1861 pleaded that Congress should act promptly in adopting the international standards. The Civil War diverted the attention of American lawmakers from world affairs, yet they were advised officially of the rapid trend to metrics abroad. Probably at no era was there more discussion of metric standardization and more general acceptance of the metric units as exclusive standards by the nations. The United States of America participated in the discussion, but unfortunately failed to act, due to internal conflict.

BRITISH PARLIAMENTARY REPORT STUDIED.

In 1862 a British parliamentary committee held extended hearings on the subject of metric standardization and unanimously recommended that the British Isles should adopt the metric system. The monumental report of the

committee, reprinted elsewhere in this volume, was laid before the Congress of the United States on March 8, 1864. Abraham Lincoln was naturally interested in this world advance as an essential measure in reconstruction, and it was undoubtedly in accordance with his views that metric legislation was introduced into both Houses of Congress.

It was in 1866 that the United States made the metric system legal, as an initial step to exclusive use of metric units at a near date. On May 17, 1866, the Committee on Coinage, Weights, and Measures of the House of Representatives urged that the use of the metric system be promoted through this legislation, declaring that "the interests of trade will soon acquaint practical men with its convenience. When this is attained—a period, it is hoped, not distant—a further act of Congress can fix the date for its exclusive adoption as a legal system."

CHARLES SUMNER AS METRIC CHAMPION, 1866.

That great American statesman, Charles Sumner, led the metric movement in the United States Senate. In a notable address on July 27, 1866, he explicitly declared: "As the first practical step to this great end (world metric standardization) I ask the Senate to sanction the bills which have already passed the other House and which I have reported from the special committee on the metric system." The metric bills were passed and become law. But the expected legislation to make the use of the metric units exclusive was not enacted. This, in the words of William G. McAdoo, was "a monumental mistake."

The British metric committee of 1862 examined more than 50 witnesses, yet declared, "We have sought for advocates of the existing system, but have found it difficult to discover them." In 1866 no objection was raised in either House of Congress to the passage of the metric legislation. It was tacitly admitted by all that exclusive metric standardization was inevitable in the near future and that it would prove very beneficial.

ORGANIZED PROPAGANDA AGAINST METRICS.

In 1871, however, the militant German Empire adopted the metric system. From that year on there has been stirred up in the world (especially in the British Isles and the United States of America) a persistent propaganda against adoption of the world metric units by other nations. Where before there was little or no opposition to the advance, suddenly there appeared a clique of professional objectors who blocked every move by the English-speaking peoples to advance to the simple decimal system. Instead, they were condemned by these obstructionists to continue bound by the cumbersome clutter of weights and measures which Germany scrapped in 1871.

It has been asserted by many competent investigators that insidious German propaganda has been constantly at work since 1871 to prevent metric legislation in the United States, and that this effort was particularly strong around 1917, when the United States entered the World War against Germany.

GERMAN PROPAGANDA CHARGED.

Paul Didier, member of the American Association for the Advancement of Science, declared in the Pittsburgh (Pa.) Despatch, October 21, 1921: "Since 1871 Germany has been on equal footing with the metric system nations, and we all know that they have thus beaten England and the United States in trade expansion. Since then, at various times, the metric system has come up for adoption in England and the United States, but it was invariably drowned by German propaganda, as they did not want either England or the United States to take away their commercial oversea holdings. If Germany could do it in 18 months, why shouldn't we do it in 9 months? Now is the time to do it, while we have nothing else to do but watchful waiting. In the meantime, put the United States scientifically on equal footing with its financial supremacy. Watch the Boche!"

Ben C. Dailey, president of the World Trade Club (Foreign Trade Club) of San Francisco, in testimony presented to Congress on October 28, 1921, indicated the tremendous advantage gained by Germany through keeping her opponents unstandardized: "Because of the standardized metric units, Germany from the outset in the war found it easy to work in concert with Austria,

Hungary, Bulgaria, and Turkey, which all had absolute military standardization on the metric system. Here was a vast advantage for the Central Powers over their adversaries—an advantage on which they had fully reckoned in launching the World War. Some observers, indeed, believe that the Kaiser would never have dared to declare war if his potential opponents had possessed such standardization of munitions and supplies. When we realize the gigantic military efficiency gained by Germany through using metric units while its enemies were handicapped with a diversity of units we may well direct our attention to the charge made by investigators of German world propaganda that the Kaiser long before 1914 had sent out the command to German secret agents everywhere, 'Hold Britain and America unstandardized at any cost until after Germany's next war.'" This same witness cited authority to show that the World War was unnecessarily lengthened at least two months through lack of initial standardization of material by the Allies, and that this meant the needless killing of 200,000 men and the needless maiming of 400,000 more.

GERMAN ANTIMETRIC INTRIGUE REVEALED.

The motive behind much opposition which has raged against metric standardization is revealed by Arthur E. Kennelly, world-known electrical expert and collaborator with Thomas A. Edison, writing in the Boston Herald, September 17, 1919: "It has often been stated in Germany that nothing would suit the German industries better than for the English-speaking peoples to remain fettered by their present complicated system of pound-foot-bushel measures, because this complex system is a handicap to the foreign trade of the English-speaking peoples, who are the principal competitors of the Germans."

The military reasons for the German effort to keep the English-speaking peoples unstandardized[1] have already been disclosed. About the time that discovery was made of the ownership of newspapers in the United States by German propaganda agencies, the powerful Pittsburgh Post pointed out the danger to America through intrusion of foreign interests seeking to keep us off the metric basis. On November 19, 1919, this journal said editorially:

"The charge that German propagandists are combating the movement for the introduction of the metric system of weights and measures in the United States has served to call attention to an advantage of the plan to which not enough consideration has heretofore been given. In inquiring into the reasons for the Teuton agents' opposition to the proposal it is alleged to have been discovered that they feared the adoption of the metric system in this country would handicap them in their efforts to win back the foreign trade which they lost to America during the war.

"Other things being equal, merchants of countries which have the kilogram and the liter as units, respectively, of weight and measure, are not going to buy goods put up in units of the pound or the quart if they can get it packed according to the method to which they are accustomed. And as Germany, in common with all other advanced nations except the United States and Great Britain, has the metric system, the Teutons think they have an advantage over this country in the competition for foreign trade. It is to their interest, therefore, to keep the system out of the United States. To this end, it is charged, they are conducting a cunning propaganda to arouse popular prejudice in favor of the retention of the antiquated and cumbersome system which we now have.

"We took a large part of this business away from Germany, and Germany is going to try hard to regain it. If it is to her interest to prevent the United States from adopting the metric system, it behooves us to give careful thought to the advantages of the plan."

SENATOR FRELINGHUYSEN MAKES DISCLOSURES.

Joseph S. Frelinghuysen, of New Jersey (who presented the metric standards bill of 1920), on December 8, 1921, placed astounding facts as to German propaganda activities before the Senate of the United States. He declared that

[1] Propaganda is not only directed against world standardization for the United States, but even against our participation in world trade at all. At the first annual convention of the Bankers' Association for Foreign Trade, held in Cleveland, Feb. 11, 1922, Dr. Julius Klein, Director of the United States Federal Bureau of Foreign and Domestic Commerce, vigorously attacked the authors of what he termed "insidious propaganda which like sand, deliberately put into bearings, is designed to slow down our export machine at the time of its greatest need." He explained that certain interests are endeavoring to minimize the necessity for greater exports, or in fact, any foreign trade at all. "This would be great for some of our crafty competitors," declared Dr. Klein.

German interests had for years maintained a lobby in Washington to prevent enactment of certain legislation there, particularly with reference to dyes and chemicals, and that the lobby is there to-day and intensely active. He declared that Germany was thus not only crippling the United States industrially but also rendering us utterly unprepared in the field of chemical warfare, and that as a result of this unpreparedness thousands of American lives were lost in the World War. Senator Frelinghuysen testified that throughout the Germans had as their allies, or dupes, a certain clique of "textiles manufacturers" who blocked legislation for the upbuilding of an American chemical industry because of their own selfish interests.

"The agents of the German interests are now here again in this Capitol," declared Senator Frelinghuysen. "Their agents are in this country. The German methods prior to the World War, from the standpoint of the dye industry and of war munitions, made this country prostrate. The history of our unpreparedness is known to everyone; but as a member of the Military Affairs Committee I made a study of certain phases of American 'statesmanship,' so called, and it is a continuous record of neglect, of lack of vision, of indifference toward national safety. * * * For 40 years the textile industries in this country had opposed a protective tariff on dyes and chemicals; the head of one great textile industry in New Hampshire organized the opposition and appeared before the Congress tariff committees. * * * The book, The Riddle of the Rhine, by Victor Lefelure, 'reveals the direct and indirect methods used by Germany to prevent, at all costs, the development of an independent organic chemical industry in the United States of America, and there are many pointed examples of the direct method.' The point I make is that Germany was organized and is organized now."

Referring to a letter sent on May 25, 1921, from the German Embassy at Rome, Italy, to the German minister of foreign affairs (and in which the phrase occurs, "It is necessary to strengthen this discontent in order to consolidate our situation through economic action"), Senator Frelinghuysen emphasized the fact that German world propaganda is most active. "I have never read any letter," he declared, "referring to trade conditions which showed more careful design in an effort to capture commercial advantage than this letter. It shows the attitude of German business efficiency. It indicates that in every country on the face of the globe there are German agents and a German system fighting to get back this trade." (See Congressional Record, December 8, 1921.)

In view of this authoritative testimony, who can doubt that the German war chest was drawn upon to keep the United States eternally unprepared for the World War which Germany long had planned? Who can doubt that the German attack on the chemical industry was made more bitter because of that industry's advocacy of metric units? Especially is this collusion with the Germans confirmed by the fact that a certain clique of textiles manufacturers worked as the dupes and allies of the propagandists, and that the spokesmen of this clique even during the war attacked the policies of the American Red Cross, seeking to prevent hand knitting by American women for American warriors, and thus materially aided the enemy in seeking to break down American morale. These same agents who "played into the hands of Germany" are to-day fighting metric standardization before Congress.

Enough has been disclosed to indicate one very great reason why metric legislation was "quashed" in the United States whenever it came up, during all that period in which virtually all the rest of the world was advancing to the standardized metric system. Metric legislation was indeed introduced, and was indorsed by all the special investigating committees in Congress; but the question was invariably "railroaded" and "sidetracked," so that a general vote of Congress on metric standardization was never attained.

CONGRESSIONAL COMMITTEES UNANIMOUSLY URGE METRICS.

It will be seen that in 1879, 1896, 1897, 1898, 1901, and 1902 the Committee on Coinage, Weights, and Measures of the House of Representatives urged metric standardization of weights and measures. These findings in favor of metrics were the result of comprehensive hearings in which all sides of the question were discussed.

The 1896 report declared: "Your committee, after a careful consideration of this subject, have unanimously reached the conclusion that the metric system of weights and measures should be put into exclusive use in the

various departments of the Government[1] at such future date as shall allow adequate preparation for the change, and at the end of a fixed time thereafter that said system shall be recognized as the only legal system for general use." The 1897 report recommended "that the adoption of the metric system for use in the Nation at large be fixed as coincident with the dawn of the twentieth century." In 1901: "Your committee recommended that the bill do pass." In 1902: "Your committee earnestly recommend the passage of the bill."

Though obstructionist tactics delayed the passage of these metric bills, the subject of metric standardization was repeatedly called to the attention of Congress. Particularly was this the case because of the growth of pan American friendship; and numerous gatherings where all the Americans were represented petitioned the Congress of the United States to make the metric advance. James G. Blaine, as Secretary of State; Lyman T. Gage, as Secretary of the Treasury; James A. Gary, as Postmaster General; James Wilson, as Secretary of Agriculture; William C. Redfield, as Secretary of Commerce; Franklin K. Lane, as Secretary of the Interior; and many other eminent Cabinet officers worked in behalf of metric standardization and advised Congress of this advocacy. Reports of agents of the Department of Commerce throughout the world, urging metric standardization for the United States, were repeatedly called to the attention of our national legislators. Congress, indeed, passed many laws approving the use of the metric units in special fields (such as in coinage, postal laws, electricity, pharmacy, and so on), and confirmed the establishment of metric weights and measures in Cuba, Porto Rico, and the Philippines. In 1901 the Bureau of Standards was established, looking to more complete standardization of weights and measures.

The Congress of the United States of America has also cooperated in the work of the World Bureau of Weights and Measures, an institution maintained under a convention of the nations. The United States of America and the British Governments contribute financially to the upkeep of this World Metric Bureau, which was established in Paris, France, under pact proclaimed September 27, 1878.[2]

In 1905–6 the New York Herald conducted a metric quentionnaire, in which the opinions of thousands of organizations, concerns, and individuals were cited in favor of gradual metric standardization; and these were placed before Congress in the form of petitions.

METRIC PETITIONS FLOOD CONGRESS.

In the years immediately preceding the World War the Congress of the United States was virtually idle on the important matter of world standardization. The main reasons for this have been revealed. Elsewhere in this volume it has been indicated, also, how in 1917–18 the United States was led to utilize the metric units in military affairs, and how this aided powerfully in gaining the ultimate victory. The people came to a recognition of the vital need for the metric advance, and petitions by the thousands poured in urging Congress to take action. A multitude of these petitions were addressed to individual legislators, and thus could not be counted; but many were addressed to Congress as a unit, and to the President of the United States. These have been placed in the custody of the United States Department of Commerce, Washington, D. C. On October 29, 1921, all the petitions were counted and found to number 102,842.

The petitions are itemized elsewhere.

It will be observed that practically 99 per cent urge metric standardization, and that little more than 1 per cent oppose. Individuals, concerns, and organizations were, of course, at liberty to send in petitions to legislators either for or against the general use of meter-liter-gram. Though opponents per-

---

[1] Samuel Vauclain, president of the Baldwin Locomotive Works, urged this procedure in his testimony before the United States Senate committee on the metric system, 1921–22.

[2] Provisions of the world agreement: Article 1. World Bureau of Weights and Measures established. 2. Special building. 3. World committee. 4. General conferences. 5. Regulations. 6. Duties of the bureau. 7. Bureau officials. 8. Prototypes of meter and 1,000 gram. 9. Expenses not to exceed 100,000 francs yearly. 10. Contributions. 11. Contributions from acceding countries. 12. Future modifications. 13. Duration. 14. Ratification, voted unanimously. It was a true world conference, and among the countries that signed were: United States of America, Germany, Austria-Hungary, Russia, Turkey, Argentine, Belgium, Brazil, Denmark, France, Spain, Peru, Sweden, Switzerland, Venezuela, Italy, Guatemala, Netherlands, Salvador. It was of this world meeting that Josh Billings remarked: "Never did so many Kaizers, Kzars, Kings, kum kling knit together in so klean a kawse to work so kommendable a kure."

sistently urged that petitions be sent to Washington, D. C., against the metric advance, the negligible results go to prove the fact that objection to metric standardization comes from only a microscopic minority. When we see the practical unanimity of people and organizations representing every known human vocation; when we perceive that they are virtually all in favor of metric standardization of weights and measures, then again comes the question, "Can an insignificant minority, by misrepresentation and clamor, obstruct an advance so necessary to the welfare of humankind?"

PROMETRIC PETITIONS MORE THAN 105,000.

The results of the nation-wide canvass of public opinion on the metric question were referred to the United States Department of Commerce at Washington, D. C. Without cost to the United States Department of Commerce, these petitions were classified and carefully counted under the direct supervision of W. Mortimer Crocker. Thousands were found to have registered their votes by postal card, but other thousands had written strong letters to Congress urging prompt adoption of the world units.

Since the tabulation many more petitions have been sent forward. Furthermore, the several thousand statements contained within the present volume in favor of metrics have been transmitted to the Department of Commerce, to be called officially to the attention of Congress. Altogether the prometric petitions number more than 105,000.

It has been pointed out already that many of these petitions are from organizations and concerns having hundreds and thousands of members, and that therefore these petitions represent directly several million voters.

STATES MEMORIALIZE CONGRESS FOR METRICS.

In 1921 the State Legislatures of California, Illinois, Tennessee, and North Dakota memorialized Congress to enact the metric standards bill. These petitions were incorporated into the Congressional Record.

STRONG METRIC ADVOCACY IN CONGRESS.

Scores of influential Members of the Congress of the United States of America are urging gradual metric standardization and have signified their intention to vote for the Britten-Ladd bill. Typical of their attitude is the statement made by Hon. Julius Kahn, Representative from California: "I believe this country can well afford to adopt the metric system. I have been in favor of legislation to that effect for the last 20 years." Hon. Arthur Capper, United States Senator from Kansas, has declared: "I shall be glad to support the metric movement in any way I can." The leadership of Senator Capper and Senator Ladd is followed by a strong group of 21 Members of the United States Senate, representing mainly the agricultural States of the South and West, who have agreed on a program of legislative activity, and press reports in 1921 stated that one of the legislative measures which they are pledged to support is the metric standards bill.

The entire country recognizes this world standardization movement as one of vital importance. Indicating the trend of opinion is an article in Automotive Industries, December 22, 1921, headed "Metric system bill a live issue," and forecasting upon advices from Washington that the bill will be reported out of conference and discussed on the floor of Congress in the spring of 1922. Scores of other publications have emphasized the vital interest in this legislative measure.

WHO URGES METER-LITER-GRAM?

PRACTICAL MEN.

To give all the statements of support for world metric standardization would be to pass in review the representatives of 99 per cent of humankind.

A few of these statements are here presented. They are typical of the virtually unanimous support that has been given the movement to secure the advantages of simple, decimal, standardized weights and measures, in the place of our present antiquated jumble of unstandardized units, inherited from the old German Hanseatic League—a jumble which Germany scrapped in 1871.

It will be apparent that only a comparatively small number of indorsements of the metric units can here be printed when it is remembered that on file with the United States Department of Commerce alone there are more than 103,000 such indorsements. There are 10,000 letters in the files of the World Metric Standardization Council urging metrics and thousands more in the files of the World Trade Club, American Metric Association, and other organizations participating actively in the world-wide metric movement. A selection from these statements has been made to indicate the support of metric standardization by manufacturers, merchants, engineers, agriculturists, authors, educators, physicians, jurists, clergymen, accountants, men of the Army and Navy, and so on. Virtually every branch of human activity is represented.

PREEMINENT AMERICANS.

[This list supplements those mentioned in testimony already given.]

John Bassett Moore, eminent diplomat, member of the world court: "I have long advocated the adoption of the metric system for the purpose of securing uniformity in the use of weights and measures throughout the world."

L. S. Rowe, Director General Pan American Union: "The United States loses business in Latin America because of persistence in using customary weights and measures in exports which are not understood and do not fit in with the industrial economics of the Latin Americans. In effect, we are trying to sell left-handed tools to people who are right-handed."

William C. Redfield, when United States Secretary of Commerce, addressing the Philadelphia Chamber of Commerce (January 10, 1917), said: "The fact, of course, is that the metric system adopted exclusively by 34 nations is simpler, easier, more effective, and more widely used than any other. It has made its way by its merits. There is no argument for the retention of our present weights and measures that is not an argument against our decimal metric dollar system. No reason supports our decimal dollar system of currency that does not support decimal system of measure. This handicap we must throw off, get out of the darkness—out of foolishness toward reason."

Theodore Roosevelt, Assistant Secretary of the Navy (March 29, 1921): "I am delighted to say that I approve of the gradual adoption of metric weights and measures by the United States of America."

Franklin D. Roosevelt, when Acting Secretary of the Navy (May 14, 1919): "I have always favored adoption of the metric system by this Nation. I believe the time is ripe for concerted action to push this through."

John Barton Payne, eminent jurist, former chairman United States Shipping Board, director of railroads, United States Secretary of the Interior: "The value of the metric system of weights and measures has been deomnstrated, and these units should be adopted by the United States of America. They are much more simple than our present cumbersome weights and measures."

Gen. Leonard Wood, Governor General of the Philippine Islands (January 21, 1921): "I am very hopeful that the question of metric standards for weights and measures will be worked out on some consistent plan which will put into effect its well-known advantages."

Arthur T. Hadley, when president of Yale University, New Haven, Conn. (September 2, 1919): "I believe that metric units are likely to come into more and more general use."

Henry Van Dyke, author and recent United States American ambassador to Holland: "I am in favor of the standardization of the measuring systems of the world by the adoption of the decimal basis, under conditions which will cause the least possible disturbance to trade."

Judge E. H. Gary, president of the United States Steel Corporation, stated, after looking over the Stratton report urging the adoption of metric units, that "he would like very much to see this report published and spread broadcast."

Scores of other statements from the most eminent Americans, and from the most eminent of humankind, are to be found in this book. Among those who voice their approval of gradual metric standarization for the United States of America are Arthur E. Kennelly, David Starr Jordan, Gen. Hunter Liggett, Albert Bushnell Hart, John Barrett, Samuel Gompers, William J. Bryan, John Spargo, George E. Vincent, Roger Babson, and many others.

PREEMINENTS OF THE PAST.

[This list supplements those listed in testimony given previously.]

For years those of wide vision in the United States of America have been working for metric standardization. In other parts of the present volume their statements have been given, and lack of space prevents reprinting them here. The reader is referred to chapters 8 and 14 for metric statements by George Washington, Thomas Jefferson, James Madison, John Quincy Adams, Charles Sumner, and other great statesmen. Some of those who have more recently urged meter-liter-gram are the following:

Andrew Carnegie: "The metric system of weights and measures is one of the steps forward which the Anglo-Saxon race is bound to take."

George W. Perkins, chairman of the executive committee of the United States Steel Corporation, organizer of the International Harvester Co. (May 20, 1919): "Believing it to be in the best interests of the unity and progress of the civilized nations of the world, I heartily indorse the proposal for adoption of metric units by the Anglo-Saxon peoples."

Theodore N. Vail, chairman of the board, American Telephone & Telegraph Co., controlling more than half of the telephones and telegraphs of the world (May 20, 1919): "I fully indorse movement for exclusive use of meter-liter-gram."

Col. Theodore Roosevelt, President of the United States of America, is quoted as saying in regard to the metric system: "We must have it."

Franklin K. Lane, United States Secretary of the Interior (February 10, 1920): "I am in full sympathy with the movement to make America metric."

Champ Clark, leader in United States Congress (September 2, 1919): "I have always been in favor of the metric system."

W. C. Gorgas, major general, United States Army, with Rockefeller Institute, International Health Board: "I am strongly in favor of metric units and will be glad to assist in having their adoption brought about."

Theodore C. Search, founder and president of the American National Association of Manufacturers, said before Congress, 1914: "Whenever manufacturers undertake to extend trade outside the United States of America and the British Commonwealths they encounter meter-liter-gram, the only weights and measures uniform through all the world."

LEADERS OF THE WORLD DISARMAMENT CONFERENCE, 1921–22.

Leaders of the various national delegations at the great world disarmament conference, Washington, D. C., United States of America, have come out unqualifiedly in favor of world metric standardization. Typical statements are here given, showing that the world is unanimous in the desire to secure promptly the advantages of metric uniformity of weights and measures.

United States of America: Elihu Root, of the American delegation, eminent jurist, Secretary of War, 1899–1904, Secretary of State, 1905–1909, United States Senator from New York, 1909–1915, declares: "I am in favor of keeping up the process by which the world may ultimately come to a general employment of the metric system."

British Commonwealths: Arthur James Balfour, chief of the British delegation, preeminent British statesman: "There can be no doubt, I think, whatever that the judgment of the whole civilized world, not excluding the countries which still adhere to the antiquated system under which we suffer, has long decided that the metric system is the only rational system."

France: Aristide Briand, president of the French delegation, Prime Minister of France (November 16, 1921): "I firmly believe that a single world-wide system of weights and measures would prove a surprisingly important factor in promoting a better understanding among the nations of the world. Naturally, it is my hope that the international metric system of weights and measures, which has already been made the single system by practically 40 nations of the world, will eventually become the single official system of all peoples. I am very happy to learn that the American Congress is now considering the adoption of the international metric system of weights and measures for the people of the United States."

Japan: Statement by the Japanese delegation (November 26, 1921): "Last April a law adopting the international metric system as the single standard

of weights and measures was passed by the Imperial Diet of Japan, and it was publicly announced that the date of its enforcement would be promulgated by an imperial ordinance. This action was taken after a thorough investigation, made by a special commission to simplify our standards of weights and measures. We were unofficially informed that the United States and Great Britain were also planning to adopt the metric system and it is our personal hope that the time will soon come when this uniform system will be universally adopted by all the countries in the world."

T. KATO.
TOKUGAWA.

Admiral Baron Tomosaburo Kato, Minister for the Navy (president of the Japanese delegation); Prince Iyesato Tokugawa, president of the House of Peers.

Italy: Carlo Schanzer, president of the Italian delegation, senator of Italy (November 17, 1921): "Italy adopted the international metric system of weights and measures many years ago and has since rejoiced over this achievement, which has increased our national efficiency and facilitated our commercial relations with a number of other countries. Italy is proud to be the home of the International Institute of Agriculture, created by our King and supported by a number of countries of the world, including the United States, and which carries on all its work on the metric basis. I believe that eventually the international metric system will be the single standard for all countries of the world. This to my mind will be an important step in human progress. Furthermore, the great number of Italians who have met with so generous a hospitality in the United States will find in the adoption of the metric system a new link which will bind them still more to the old Latin civilization and which will give them not only material benefits but great moral advantages."

China: Sao-Ke Alfred Sze, president of the Chinese delegation, minister of China to the United States of America (December 7, 1921): "In 1914 the Republic of China promulgated a weights and measures law which established a dual system, one being the standard metric units which is in use in so many countries, and the other being our own system of measurement which has been in force in China for so many centuries. You can, of course, realize the difficulties which we have encountered in making changes from our old system to the new, but it is my understanding that the modern metric system is gradually coming into use, especially upon the railways. I am, of course, thoroughly in sympathy with a plan that would provide for general standardization of weights and measures throughout the world."

Belgium: Baron E. de Cartier de Marchienne, president of the Belgian delegation, ambassador from Belgium to the United States of America (December 1, 1921): "Belgium adopted the metric system as far back as the end of the eighteenth century, and economically as well as scientifically has derived from it great advantages. One readily understands this fact when one remembers the difficulties which complicated the most usual commercial relations between the inhabitants of the different Provinces of old Belgium, where various standards of weights and measures existed. I am convinced that when the metric system will have become common to all civilized nations a true progress will have been achieved."

Holland: Jonkheer H. A. Van Karnebeek, president of the Netherlands delegation, Netherlands Minister of Foreign Affairs, president of the League of Nations Assembly (December 12, 1921): "Holland has long realized the value of the international metric system and adopted it. I am confident the increasing volume of international trade tends to intensify the inconvenience of the simultaneous application of different standards and makes for uniformity. World commerce outgrows more and more the codes of individual countries and demands with ever stronger emphasis rules of universal scope. I believe this is particularly true in regard to weights and measures."

Portugal: Viscount d'Alte, president of the Portuguese delegation, minister of Portugal to the United States of America (Dec. 7, 1921): "Portugal was one of the first countries that adopted the metric system, in the year 1868. In a few years the sysem became so popular that now the old standards dating, some from the time of the Romans and some being much older, are nearly forgotten, everybody feeling happy to use a rational interconvertible system of weights and measures. For my part I anticipate great advantages from uniform standards in all nations."

MANUFACTURERS AND MERCHANTS.

The greatest manufacturers and merchants in the United States of America have come out strongly in favor of gradual metric standardization. There are 15,501 petitions from manufacturing concerns, manufacturers and their engineers on file with the United States Department of Commerce, urging metric standardization. These petitions represent concerns with an aggregate invested capital of several billions of dollars. Some of the typical statements, from among these thousands, are the following:

Allied Chemical & Dye Corporation (capitalized for more than $300,000,000), through Wm. H. Nichols, chairman, 61 Broadway, New York City (Mar. 16, 1921): "This corporation, like all other chemical institutions, is in favor of the metric system, and personally have been more or less active in furtherance of the matter for some time past. I am aware of the objections to the change, but believe that the difficulties in making it would be found to be very much less than many of its opponents believe."

Ford Motor Car Co., through Henry Ford, president: "We heartily approve of any step toward the adoption of the metric system in our industries. It appears there is no better time than now." (Manufactures more than 60 per cent of all automobiles in the United States of America.)

Goodyear Tire & Rubber Co., through P. W. Litchfield, vice president (1920): "We are heartily in favor of the international metric standard." The Goodyear Co. now makes extensive use of the metric units and announced its decision to adopt them exclusively.)

Crane Co. (59 branches, manufacturers of about 20,000 articles, steam specialties), through R. T. Crane, jr., president: "We have for 10 or 12 years advocated the metric system, which we thoroughly believe in."

United Light & Railways Co. (19 subsidiary operating companies), through R. Schaddelee, vice president (Mar. 18, 1921): "Our organization is strongly in favor of the introduction of the metric system in our country, and we do not care who knows it."

Simmons Co. (large manufacturers of iron and steel articles, Simmons beds, so on), through O. B. d'Aoust, secretary: "We do not hesitate to give our indorsement for the adoption of the rational metric units." The president of this concern, Zalmon G. Simmons, is a member of the advisory committee of the World Metric Standardization Council.

Emerson-Brantingham Co. (large manufacturers of agricultural implements, gas and steam engines, carriages, sawmills, and so on), through A. T. Jackson, vice president, Rockford, Ill. (Mar. 16, 1921): "We authorize you to go ahead and list our concern as being entirely favorable to the metric movement and ready to support its activities."

Morris & Co. (large packers and provisioners), through Theodore Sanders, Chicago (Jan. 10, 1921): "In reference to the metric system, this movement has our sympathy and moral support.

Miller Rubber Co., of New York (incorporated for $60,000,000), through C. E. Wagner, export manager: "We have signed petitions for the adoption of metric weights and measures."

J. B. Brady, general manager, Pacific coast division, United State Rubber Co. (incorporated for more than $100,000,000), San Francisco, Calif.: "You can rest assured of my sympathy with this movement you are undertaking."

Charles A. Mead, vice president E. I. du Pont de Nemours & Co., Wilmington, Del. (Jan. 24, 1921): "Of course, in our chemical work we are on a metric basis at the present time, although our machines and equipment as a rule are not. There is no doubt but that we shall steadily extend the use of the metric system in all our work."

E. N. Brown, president National Railways of Mexico, 120 Broadway, New York City: "I will be very glad to do what I can to further this metric work, believing that it is in the interests of all and that it is a much simpler system than our present system of weights and measures."

Samuel Vauclain, president Baldwin Locomotive Works (annual sales, $80,000,000): "We could change to the metric system, or we could use both systems, without incurring any appreciable expense at the time. My opinion, however, is that were we all using the metric system it would be much more convenient to the workmen, and our errors would be appreciably less than they are at present."

James W. Cain, vice president United States Fidelity & Guaranty Co. (incorporated for more than $25,000,000), Baltimore, Md.: "This is a subject to

which I have given much thought and attention, and I am firmly of the conviction that we should without further delay take such steps as are necessary for the introduction of the metric system as the legal standard of weights and measures."

Edward Prizer, president Vacuum Oil Co., New York City (surplus, $57,646,000): "The advantages of the metric system I quite appreciate, particularly in view of the fact that in our foreign operations we are necessarily obliged to use it in whole or part."

George W. Dickerman, vice president Remington Typewriter Co., New York City: "The writer believes thoroughly in this simple, logical system of measurements and of weights and would like to see it adopted."

International Textbook Co. (giant world concern owning the capital stock of the International Correspondence Schools, and so on), through Rufus J. Foster, chairman executive committee, Scranton, Pa. (October 1, 1920): "As an institution we are heartily in favor of the adoption of the metric system."

Waltham Watch Co., through Conover Fitch, vice president, Waltham, Mass.: "The Waltham Watch Co. adopted the metric system in 1868, about 12 years after the establishment of the company, and has used it exclusively ever since. We have found it much better for our needs and have done everything we could to advance its adoption."

Hammond Lumber Co. (incorporated for more than $10,000,000), through A. B. Hammond, president, San Francisco, Calif.: "We favor the promotion of world trade and national efficiency through metric standardization of weights and measures. We urge that the metric units be made the exclusive legal standards of weights and measures within the jurisdiction of the United States of America."

Shredded Wheat Co., Niagara Falls, N. Y.: "We urge that through legislation or promulgation the units of the metric system of weights and measures be made the exclusive legal standards within the jurisdiction of the United States of America."

Kellogg Toasted Corn Flake Co., Battle Creek, Mich. (March 21, 1921): "We favor metric standardization of weights and measures, and we trust its adoption is not far distant."

Certain-teed Products Corporation (large manufacturers of paint, roofing, and related building products), through R. M. Nelson, treasurer: "We are in favor of this (metric) movement."

Hydraulic Pressed Steel Co. (large manufacturers of standardized steel articles), through G. C. Brainard, general manager: "We are firm believers in the metric system of measurement and believe that its universal adoption would very materially simplify and facilitate all computation in connection with our manufacturing business."

J. B. Williams Co. (shaving and toilet soaps and toilet articles), through E. B. Hurlburt, Glastonbury, Conn. (Mar. 29, 1921): "We most heartily favor a change to the metric system, and we are aware that a departure of this sort entails a certain amount of inconvenience and more or less irritation, but we are confident that the gain to be made will be immeasurably greater than any inconvenience incident to the change."

Diamond Crystal Salt Co., through R. R. Moore, vice president, St. Clair, Mich. (Mar. 28, 1921): "We will be glad to be listed among those American manufacturers advocating the adoption of metric units during a gradual transition period."

Williams & Cunnyngham, through V. L. Cunnyngham, treasurer and manager, 78 East Madison Street, Chicago, Ill.: "We represent advertising of concerns whose business represents more than a billion and a quarter annually. We recommend that the meter-liter-gram method be adopted."

Briscoe Motor Corporation (large manufacturers of motors and munitions), through Victor Jantsch, engineer, Jackson, Mich.: "Our opinion is that the metric system is a coming system of measurement, as it is already used generally in the scientific laboratories and in medicine, and also is in general use for electrical measurements. We firmly believe that it will be only a matter of a few years when the metric system will be adopted for general use." (Now Earl Motors Co.)

Roxana Petroleum Co., of Oklahoma, through S. Petersen, St. Louis, Mo.: "We are strongly in favor of the campaign for world standardization of weights and measures through the adoption of metric units by the United States of America."

Victor Animatograph Co., Davenport, Iowa: "We are heartily in favor of the adoption of such a universal standard, which would be of great assistance to our photographic department."

Truscon Steel Co., through Julius Kahn, president: We thoroughly sympatize with and desire to encourage metric standardization." (See also statement of Vice President Page, of this company.)

Standard Steel Car Co. (large manufacturers of automobiles, and so on), through A. Christianson, chief engineer, Butler, Pa.: "We are heartily in favor of the adoption of the metric system of weights and measures throughout the world." (He sent testimony to Congress to this effect.)

Tacony Steel Co. (large manufacturers), through W. F. Mulhall, Philadelphia, Pa.: "The universal adoption of the meter-liter-gram system can only be accomplished by congressional action, which action can just as well be initiated now as it will inevitably be in the future."

Elwood Haynes, president Haynes Automobile Co. and Haynes Stellite Co.: "With all of America's up-to-date methods we are still disgraced and burdened with an antiquated system of weights and measures. The time for changing to the metric system can never be better than now. The same objections to making the change now were urged 40 years ago." (See also his testimony before Congress, printed elsewhere.)

E. C. Danner, superintendent order department, Cambria Steel Co., Johnstown, Pa: "I am strongly in favor of the metric system and will gladly cooperate with any reasonable plans your standardization council may formulate."

Lazard Kahn, vice president Estate Stove Co. (large industrial concern), Hamilton, Ohio (March 17, 1921): "American adoption of metric standardization for weights and measures would be an act of business engineering and statesmanship whose large economic, financial, and moral benefits can not be logically doubted or reasonably computed. Practices in national or international trade which invite and do not eliminate confusion and misunderstanding are, in fact, retarding the achievements sought for."

Albert Herbert, for many years president and treasurer of Leolastic and director of Everlastik Corp., chairman of the standardization committee, American delegation, International Chamber of Commerce, 1920: "It is surprising that metric standardization was not brought about long ago. No one objects to it except a microscopic minority."

De Laval Separator Co., through T. H. Miller, works manager, Poughkeepsie, N. Y. (March 16, 1921: "This works adopted the metric system some 12 or 14 years ago in all its designs of machinery and parts and has used it ever since to its great advantage, which is, of course, most marked in studies and calculations leading to designs. The cost has been nothing that could be found. It was, of course, not necessary to throw away any designs already existing, but merely to express dimensions in the metric system, and it was not necessary to scrap any machinery or tools, in spite of the claim that such necessiy is one of the great disadvantages." (See his testimony before Congress.)

J. G. White Engineering Corp., through Gano Dunn, president: "Formerly somewhat prejudiced against the metric system, we have changed our point of view on account of finding it convenient, simple, and less liable to error in drafting and specification, so that we now welcome it and would be glad to see its universal employment."

James Inglis, president American Blower Co. (large fan, blower, and engineering business): Though Mr. Inglis formerly opposed the adoption of the metric weights and measures, he has now come to favor metric standardization. This is typical of many manufacturers who formerly had not thoroughly "looked it up." Mr. Inglis writes: "I shall be pleased to be counted among those who are favorable to the passage of the metric standards bill." Speaking of a meeting of the executive and engineering heads of the American Blower Co., Mr. Inglis said: "On the whole, the adoption of the metric system was favored."

Curtiss Engineering Corporation, through Glenn H. Curtiss, president, Garden City, N. Y.: "I have no hesitancy in indorsing the adoption of metric units as standards. It would certainly be a great boon to science, art, and industry."

Poole Engineering and Machine Co. (large industrial concern), through A. S. Baldwin, chief engineer, Baltimore, Md.: "We are strong believers that universal standard measurements should be adopted, and that the metric system is the proper one."

A. Stein & Co. (manufacturers of Paris garters), through T. E. Parry, Chicago, Ill. (May 6, 1920): "We are earnestly in favor of seeing the metric system used as a standard all over the world."

Western Clock Co. (makers of "Big Ben" and other world-famous "Westclox"), through the board of directors, Peru, Ill. (November 8, 1921):

"Whereas there is in the United States a deplorable lack of uniformity in weights and measures, and the units are unscientific, cumbersome, and unrelated, constituting an actual hindrance to education, industry, world trade, and the activities of daily life; and

"Whereas the metric system of weights and measures is a demical system, simple, logical, and easy to use, so that its adoption will result in an incalculable saving in time and energy; and

"Whereas the metric system has been adopted by the vast majority of enlightened nations, and its adoption by the United States is calculated to promote friendly relations and commerce with all the world; and

"Whereas the manufacturing industries of the State of Illinois and the country at large are particularly interested in the adoption of the uniform and universal system of weights and measures known as the metric system in order to facilitate production and to hold and improve world trade: Therefore be it

"*Resolved*, That the board of directors of the Western Clock Co. strongly advocates the passage of Senate bill 2267, known as the Ladd bill, as a just, wise, conservative, and constructive measure, and respectfully urges that the units of the metric system be adopted by the Congress of the United States as the legal standard of weights and measures after a transition period of 10 years, as proposed in bills now before Congress."

Automatic Electric Co., through Grant Pelton, vice president, Chicago, Ill. (May 9, 1921): "The metric system is needed by the industries of this country and we hope that the bill will pass for the following reasons:

"(1) The present system of weights and measures is nondecimal and places upon us a burden of calculations and tabulated data which the metric system removes, and a ceaseless vigilance against error due to the composition of the units which the metric system greatly reduces.

"(2) The metric system is made up of units which are naturally related to each other by decimal relations—the system is completely homogeneous. It reduces the mental labor in measuring, weighing, computing, and recording and reduces the probability of error.

"(3) Our research department has been using the metric system exclusively for a number of years, both in research and in design, and has found that it is vastly superior to the old system.

"(4) We propose, as soon as it can reasonably be done, to convert our entire factory to the metric system, not changing any of our dimensions, but simply measuring them in metric units. We have surveyed our factory by departments to see what changes are necessary, and are surprised at the small cost which it involves.

"(5) We employ 3,000 people and are growing.

"(6) We have experimented with teaching the metric system to people and have found that it is picked up with great ease and speed." (See testimony of Automatic Electric Co. before Senate Metric System Committee.)

A. B. Farquhar, president A. B. Farquhar Co. (Ltd.) (manufacturers of farm implements and heavy machinery), York, Pa.; vice president Chamber of Commerce of the United States; author "My 64 Years in Business": "The metric theory is sound in principle and is therefore bound to prevail sooner or later."

Atlas Ball Co. (now of S. K. F. Industries), through W. F. Shellinger, superintendent, Philadelphia, Pa.: "After years of experience in manufacturing precision balls for ball bearings, we think it would be a great advantage to American and British industry if the metric system of measurement were adopted in the United States and the United Kingdom, practically the only two countries where the metric system is not in general use."

George Schuhmann, vice president and general manager Reading Iron Co. (large manufacturers of wrought-iron pipe, and so on), Reading, Pa.: "The use of the antiquated systems is time-consuming, uncertain, and nerve racking. For the average daily practice the metric system is much easier on one's mind, and a still greater mental labor saver to those who have to calculate much in volumes and weights."

Liondale Bleach, Dye & Print Works, (Inc.) (large manufacturers), through S. J. Loewenthal, Rockaway, N. J.: "We understand that movement is under way to secure the adoption by our Government of the universal use of the metric system. We are very much in sympathy with a movement of this

character, as we feel, as manufacturers, that it would greatly simplify the handling of our product, especially in foreign markets."

M. H. Hopkins, president and general manager O. & W. Thum Co. (manufacturers of Tanglefoot fly paper, and so on), Grand Rapids, Mich., (March 26, 1921): "The writer personally favors a gradual adoption of the metric standard."

Dow Wire & Iron Works, through W. H. Logan, president, Louisville, Ky.: "We are heartily in favor of the metric system."

Lucey Manufacturing Corporation (large manufacturers of pumps, engines, drilling tools, and so on—12 branch offices), New York City: "We have indorsed exclusive use of the meter-liter-gram."

Frank C. Munson, president Munson Steamship Lines, New York City (February 10, 1921): "I am in favor of the introduction of the metric system and will do what I can to influence legislation in that direction."

Hamilton Watch Co., Lancaster, Pa.: "There is an effort being made to have the United States Government adopt metric weights and measures, and we take this opportunity to say that in our opinion this would be a great convenience."

Chase Metal Works (large manufacturers of sheet and tubing), through W. B. Fairfield, Waterbury, Conn.: "The undersigned indorses any activity that will bring about the exclusive use of meter-liter-gram by the United States of America."

B. T. Babbitt (Inc.) (large manufacturers of soap, washing powder, and so on), through L. S. Bernheim, treasurer, New York City: "We know from long experience the great advantage of the decimal system in coinage, and it is very apparent that the advantage will be fully as great in the matter of weights and measures."

Charles Cooper & Co. (large manufacturing chemists and importers), through R. J. O'Grady, New York City: "We indorse any activity that will bring about the exclusive use of the metric system by the United States of America."

E. Ingraham Co. (large manufacturers of clocks and watches), through D. S. Ingraham, Bristol, Conn.: "We take this occasion to indorse any legitimate ways and means that will bring about the exclusive use of meter-liter-gram by the United States of America."

Ludlow Valve Manufacturing Co. (large manufacturers of high-pressure valves, fire hydrants, and so on), through J. H. Caldwenn, president, Troy, N. Y.: "We favor exclusive use of meter-liter-gram by the United States of America."

Habicht & Co. (large manufacturers of bakers' supplies), New York City: "We are in favor of the world-wide use of metric units."

B. F. Nelson, B. F. Nelson Manufacturing Co. (large manufacturers of building paper, and so on), Minneapolis, Minn.: "I have been for several years very much in favor of the adoption of the metric units in place of the present ungainly system which we are using."

Beech-Nut Packing Co., Canajoharie, N. Y.: "We are in favor of the metric system."

Celite Products Co., New York, Chicago, Pittsburgh, Los Angeles, San Francisco, through H. H. Krieger, general manager: "Such work as you are doing is unquestionably of very great value. We wish you well."

American Insulated Wire & Cable Co., through M. B. Mervis, secretary, Chicago, Ill.: "We are very much in favor of this move."

R. H. Long Co. (manufacturers of boots and shoes and shoe machinery), Framingham, Mass.: "We believe that if the metric system can be universally adopted that it will result in much benefit to the whole world."

Baltimore Canning Co., Baltimore, Md.: "We think it is time our country was awakening to the necessity of using the meter-liter-gram."

Litchfield Manufacturing Co., Waterloo, Iowa: "We have taken action in favor of metric standardization of weights and measures."

P. D. Wagoner, president General Vehicle Co. (Inc.) (large manufacturers of electric and commercial gasoline automobiles), Long Island City, N. Y.: "The mechanics prefer the metric system, having once used it. In addition, most American shops have an appreciable percentage of foreign mechanics who have been trained to use the metric system in their native country."

C. K. Anderson, president American Wire Fabrics Co., Chicago, Ill.: "We have had considerable business from various countries that are now using this system and we frequently have put up goods under the meter measurements, and as all countries except the United States and the British Isles are using it, why should not the English-speaking people and merchants have the best?"

National Oil Products Co., through F. Fader, purchasing agent, Harrison, N. J. (November 2, 1921): "We believe this is a very good and worthy movement."

Getz Bros. & Co. (Inc.) (large exporters and importers); through M. G. Frankklin, treasurer, San Francisco, Calif., April 2, 1921): "Through dealing with all parts of the world, we find that our domestic standards of weights and measures are a distinct advantage. We shall welcome the day when the metric system is finally adopted by our country."

Thomas Spacing Machine Co., through G. P. Thomas, president, Pittsburgh, Pa.: "We are manufacturers of heavy machinery and we believe that the universal system of measure based on the metric system is essential. Nothing but blind prejudice and unwillingness to learn a new system stands in the way of its adoption."

Carl E. Schmidt & Co., tanners, through N. J. Schorn, Detroit, Mich.: "Regarding the estimated cost, I can not comprehend any such figures as some of the advocates of the obsolete system present. As far as we are concerned, if the Congress were to make the metric system the only legal system to-morrow, we would merely change our graduations on the beams to fit the less complicated system." (See testimony of David Molitor, of this concern, before Congress, 1921.)

American Bosch Magneto Corporation, Springfield, Mass., through P. R. Mayer, superintendent: "Our entire manufacture is based on the metric system. The argument that the introduction of the metric system throughout the United States would revolutionize our industries and entail colossal losses is sheer nonsense. It will, however, be cheaper to the country to introduce the system now instead of waiting another decade. It should be borne in mind that 50 per cent of the difficulties have been already overcome by the very fact that the system is now being taught in our primary schools and on account of its well-nigh exclusive use in scientific laboratories throughout the country. To my mind, there is nothing in the way of an immediate adoption of the metric system except the removal of the entirely unfounded fear of some shortsighted people. * * * To be sure, the manufacturer is the one that has to consider seriously the adoption of the metric system sooner or later. The sooner, however, the better—and the cheaper. We are the makers of the Bosch magneto, a product which is universally known; and the success of the Bosch magneto is in no small measure due to the metric system. * * * Regarding the changing over of machine tools, this is only necessary where actual metric readings are required. These machines are mostly used in tool rooms and represent not more than 10 to 15 per cent of the equipment of any manufacturing plant. Even among the 15 per cent, it will be found that some machines, especially lathes, are equipped to work to metric dimensions, thus cutting the cost of change down further. It becomes apparent at once that the colossal losses are overestimated and should really be termed negligible."

California Wire Cloth Co., through C. Zook Sutton, vice president, San Francisco, March 12, 1921: "We have watched with increasing interest the efforts of the World Metric Standardization Council to stimulate to realization the dormant mind of the average American business man relative to the great possibilities awaiting us in the form of metric standardization. The potential good to be derived therefrom has as yet not been conceived even by the most ardent enthusiasts, nor will it be manifest until we have actually had the opportunity of trial, of putting it to daily use. Then only will we awake to the stupidity of having closed our eyes to this simple, inexpensive, time-and-money-saving factor, conceded by most commercial nations to be of absolute necessity. In our own business we are daily wasting time and money converting our obsolete inch, foot, yard, and rod units to square measure, and vice versa. The same economic loss is being carried on in hundreds of thousands of American institutions and will continue until such time as we adopt and make exclusive the use of the 'metric standard of weights and measures.' Our views on this subject are the results of a careful investigation which has been made in our line with the idea of decreasing production costs and overhead. The advantages referred to in the use of the metric system are not idealistic predictions, but are based on concrete facts, and a year's application of the system by the writer while serving in the capacity of captain of Artillery with the American Expeditionary Force. (Having grown familiar with the use and advantages of the metric system as a battery commander in France, I find it difficult and anything but efficient to work with the old English system.) (If the bill now before Congress passes, I venture to say that only a small fraction of the 10

years allowed will be required to demonstrate the simplicity, efficiency, and importance of the metric system."

Graham Roller Bearing Corporation, Coudersport, Pa., through D. F. Graham, sales engineer, January 10, 1921: "We certainly favor the gradual adoption of metric standardization of weights and measures in the United States, and will do all in our power to further same. We use the metric system entirely. It is impossible for the writer to believe that the cost of changing (for the country at large) would be very great, for the reason that at the start dimensions could be given in millimeters and decimals, holding to the present sizes and dimensions of parts and material. It would be the easiest thing in the world to gradually change to metric dimensions as time went on; and we find that there are practically no dimensions used today in even inches where any accuracy is required, but that all dimensions resolve themselves in inches and fractions, usually 1,000ths of an inch. This can just as well be given in millimeters as in inches. It would of course mean some very careful, earnest work to be done by the engineering department of the various factories, but as far as the factory itself is concerned, we believe that the change could be made with almost no break whatever."

Peerless Color Co., Bound Brook, N. J., through R. W. Cornelison, president and general manager (February 1, 1921): "I wish to express myself as very favorable to the metric standards bill. It is not drastic legislation which would make our measuring machines and standards antiquated, but the transition is to be brought about in a period of 10 years. There are a lot of old fogies who oppose the metric system. * * * The transition for the manufacturer is not so great as he at first might suppose. With the metric system, there is no inconvenience and much less liability to error."

Matthiessen & Hegeler Zinc Co., smelters and manufacturers, La Salle, Ill., through the president (November 26, 1921): "The business interests of the United States of America would be greatly benefitted by the Britten-Ladd bill (H. R. 10, S. 2267). We feel that it can be only a matter of a little time when a measure of this kind will be approved."

W. R. Grace & Co., through M. Bouvier, secretary, some years ago declared: "All the Latin-American countries use the metric system of weights and measures, and we find it necessary to convert our pounds, yards, and gallons into the equivalents of the system understood in the section to which the goods are shipped. Of course, it would simplify matters a great deal if we used the metric system in the United States. As it is, we buy here in one system and sell abroad in another. A uniform system would save a great deal of labor."

Sargent & Co., New Haven, Conn., also New York and Chicago, announce in the National Hardware Bulletin, November, 1921: "The unit or decimal system of pricing and packing hardware, which we have adopted and are now using for our product, appeals to most of our customers, and its adoption has met with their hearty approval. We received many letters of approval from leaders in the industry, while resolutions of indorsement were received from trade associations. Advantages of the decimal system: It saves time, reduces labor, and lessens the liability of error in sales and accounting work by simplifying the mathematical operations necessary to arrive at a price. This change in trade methods is a great advance that will be more and more appreciated as it is used and its use is extended."

Meyer Scale & Hardware Co., Newark, N. J. (May 14, 1919): "As manufacturers of weighing equipment in all standards known throughout the civilized world, we unhesitatingly recommend and advocate the exclusive use of 'metric system.' We feel that this is the psychological moment for its adoption by the great English-speaking nations of the world, in order to facilitate the intercourse between ourselves and all other parts of the world, which, as is well known, have already adopted the metric system."

Fred B. Strunk, general storekeeper Dahlstrom Metallic Door Co., Jamestown, N. Y. (November 25, 1919): "My work as general storekeeper of a steel products manufacturing plant has convinced me that the only way to get away from our present complicated and cumbersome system of gauges, weights, and measures is to use only a common-sense method, the metric system."

Tablor Electric Co., Red Wing, Minn. (June 2, 1919): "It is the writer's opinion that no one act of legislation could confer a greater benefit on the commercial industries of the nations of the world than the standardization of the meter-liter-gram unit."

George P. Blow, president Western Clock Co., LaSalle, Ill., member standardization committee, International Chamber of Commerce (November 19, 1921):

"The metric standard's bills (H. R. 10; S. 2267) were specially drawn to meet the objections of some manufacturers, who have been convinced, by opponents of 'metrics,' that any change of system would involve scrapping of tools, dies, nuts, bolts, machines, and other appliances; and thus cause the expenditure of 'millions of dollars.' For this reason it is provided specifically: (1) That the change shall apply to purchase and sale (merchandising) and not to any method, tools, or appliances used in fabrication or manufacture; (2) that ample time (10 years) be given to prepare for and adopt the new system; (3) that exception may be made for goods intended for foreign countries using the old system—Great Britain and colonies. It will be seen, therefore, that manufacturers are more interested, and have received more consideration, than any other group of citizens; and it is hoped and believed that they will show their appreciation by prompt action in their approval and indorsement."

O. L. Lewis, chief engineer Southern Motor Manufacturing Association (Ltd.), Houston, Tex., formerly chief engineer tractor department, Moline Plow Co., Moline Ill. February 24, 1920: "The losses of time, if the present system is continued in use, will extend indefinitely through hundreds and hundreds of years, amounting to a mass of energy that is unthinkable in this age of efficiency; while the inconvenience caused by the change to metric units will be of short duration. The writer has been connected with educational projects, shop management, and engineering since 1904 and feels that considerable agitation against the metric system is due to near-sighted business policy rather than the consideration of the real merits of the case."

Hawkeye Wrench Co., Marshalltown, Iowa, through H. E. Woodward, manager, April 26, 1920: "We are very much in favor of metric standardization of weights and measures. We feel that the added convenience and time-saving features of this system would very much more than offset the costs of changing over out present system. This could be taken care of gradually by discontinuing the old system of measurements when making up new tools and in adding new lines."

Lionel Hagenaers & Co., New York City, (May 8, 1919): "We are much in favor of the metric system." (Lionel Hagenaers, head of this world trade concern, is president of the Belgian Chamber of Commerce in the United States.

American Sponge & Chamois Co., New York City (July 26, 1919): "We are heartily in accord with the metric system."

Godfrey L. Cabot, great manufacturer; owns five factories and works; built Grantsville Carbon Works, West Virginia (largest in world); vice president Carbon Black Association; world aviation authority (February 17, 1920): "Once adopt the metric system and our commercial supremacy is assured."

Cutter & Wood Supply Co., 68 Pearl Street, Boston, Mass. (May 2, 1919): "For 30 years we have been supplying to manufacturers of machinery and mechanical specialities our various lines of mechanical goods, precision tools, so on. While we realize that a radical change in the present measuring system would seriously inconvenience temporarily these manufacturers, owing to the necessity of changing tools, jigs, measures, so on, we feel certain that in the end a change by the United States of America to a universal decimal standard of computation would be a constantly increasing source of advantage." (The Britten-Ladd bill provides a gradual transition, not a radical change, with all interests protected.)

G. H. Duncan, of the Annett Box Co., East Jaffrey, N. H.: "The desirability of bringing about the use of meter-liter-gram was particularly called to our attention to-day when we were figuring the cost of a partitioned lining for a box, the lining consisting of splints 18 by $\frac{3}{16}$ by $\frac{1}{16}$ inch and other pieces $12\frac{1}{2}$ by $5\frac{1}{4}$ by $\frac{1}{16}$ inch, and it was necessary for us to find the amount of lumber in 12,000 of the smaller pieces and 5,000 of the larger pieces. Of course, it was possible to do this. As a matter of interest, we found that it required about 220 board feet of lumber, but we could not help thinking how much simpler it would have been to have figured this in decimal fractions of a meter. These problems are arising in hundreds of thousands of industrial plants every day, and it would be a tremendous saving of time the country over were the metric system established as the universal standard."

H. Seydel, president of the Seydel Manufacturing Co., Jersey City, N. J.: "There seems to be some sentiment in favor of retaining the archaic system of weights and measures that we are now burdened with. Having been raised in Belgium, the writer is well acquainted with the metric system and can only

say that in Belgium 9 people out of 10 know the size value of whatever is put before them, whereas our business experience has been that very, very few of the men we employ could ever be taught the comparative values of the obsolete system we now have, which system we believe is somewhat the cause of the difficulties we experience in the exportation of our products."

M. Weill, president of the Illinois Smelting & Refining Co., Chicago: "We have addressed legislators so hot that we nearly burned the paper. I think the only way to get the metric system is by money. I am willing to subscribe $100 for the purpose and there should be 1,000 others if not 10,000 who would give from $10 to $10,000 if they are at all wise, and get the money back in a year; yes, in a month by the saving accomplished. What is everybody's business in Congress is nobody's business." Letter to World Trade Club December 20, 1919.

Du Pont Food Products Co., Baltimore, Md., through A. F. Du Pont (May 15, 1919): "We use exclusively the metric system in our factory—the work is much more accurate and scientific. As you will see in the inclosed circular, we have an extensive export trade. Outside of the British colonies nobody bothers with such an obsolete system as the English avoirdupois."

A. J. P. Bertschy, president and general manager Bertschy Engineering Co., Cedar Rapids, Iowa (January 12, 1921): "We are manufacturers of a high-grade machine tool. We are catering to the foreign as well as domestic trade. I feel rather silly when I stop to think that I am sending one of our machine tools manufactured according to American standards to a foreign customer and ultimate user. Furthermore, if the average machine-tool manufacturer would take the time or stop long enough to check carefully over the tracings or blue prints affecting his product he would himself become confused. Not once has he been able to rid himself of the complex situation which arises, regardless of how careful and efficient the organization is. We deal now in sixty-fourths, thirty-seconds, sixteenths, eighths, and fourths, and when our engineers desire to specify a tolerance, they can not refer to it as sixty-fourths, they must therefore specify one-thousandths. Again, we have to use the drills in sixty-fourths, and so on down the line until we have accumulated a large stock of tools, saying nothing about the fixtures and jigs, but referring only to drills, reamers, taps, and similar other standard or manufactured tools which could be reduced by one-half if the metric system were adopted. Therefore the statement made by some that the metric advance would be expensive is not founded upon actual facts. I consider it of vital importance that the present system be entirely eliminated. I will be glad to assist in every way possible to bring about this advance which will be as great a benefit to America as any improvement or invention that has ever become of commercial value."

Morgan Drug Co. ("Success" remedies), through R. G. Meggy, export sales manager, and approved by Charles O. Johanot, president, Brooklyn, N. Y.: "We hereby add our appeal to that of others who believe that legislation should be adopted by the United States—the greatest country in the world—to improve its efficiency as such. Though the greatest country in many respects, it is still fettered in others. It is fettered in dealings with more of the other nations—bound by ties of its own adoption—bound by ties which can not but circumscribe its efforts and increase its difficulties, not merely at home but especially in its dealings with other nations.

"To teach its young the simplest operations in connection with weights and measures—part of the vital fluid of business—it still inculcates in their minds a confusion of tables, which are each not only hard to remember (in comparison with what could and should be taught), but also are not connected by any system of common sense. The units of one kind of weight differ entirely from that of another, and the same is true in connection with measures, whereas by learning the basic principles of metric equivalents in connection with one measure or weight the student can understand that of all others.

"If the present confusion were unavoidable, if there were no remedy, such a state of things must necessarily continue, but no thinking man can say with truth that such is the case.

"If a man has an ulcer, which threatens his very existence and which can only be removed by a major operation, he goes to a surgeon and has that operation performed, no matter what the cost, no matter how intense the pain.

"Should not, therefore, a nation with such an ulcer be willing to go to any expense to have it removed, in order that such nation may cease to be the laughing stock of other and smaller nations with larger brains for that prin-

pal object. It would be at no sacrifice of national pride, and the cost would ›on be more than balanced by future benefits derived.

"The writer is an engineer, a corporate member of the American Society of ;ivil Engineers, and knows that he is not suggesting something which is impossible of fulfillment.

"Many years ago it was found necessary to equip all the freight cars of the :ountry with airbrakes, and although the cost was enormous it was done, not ;y arbitrary legislation, compelling an immediate change, but by gradual evolu- ion extending over a period of several years.

"The writer therefore suggests that such a course be pursued in connection with the national ulcer under discussion. The Government found it necessary to adopt the metric system in some of its operations in order to cooperate more fully with its allies in the war. We would therefore suggest that it finish its work and create legislation making the metric system the legal and only method to be used as standard after a future date, as near to the present as may seem advisable.

"Individual action is practically out of the question, and legislation making such a change compulsory would, while possibly appearing arbitrary to the unthinking, be a national blessing."

It has already been mentioned that more than 15,000 manufacturers and engineers have petitioned the Congress of the United States of America to enact metric standards legislation. In the congressional metric hearings of 1907 (p. 58) the statement is made:

"Analysis made of the numerous petitions urging the metric units and presented to Congress shows that the great majority of the signers are practical business men. A card index containing 1,674 names of petitioners in the business section of Manhattan shows that of these 61 are machine and tool makers, 398 are general manufacturers, and 695 are merchants."

A list of all the manufacturers and merchants urging gradual metric standardization would take up many volumes. Here are a few chosen at random from among the very largest concerns in the United States of America:

George C. Scott, vice president United States Steel Products Co., 30 Church Street, New York City. (April 27, 1920.)

John C. Runkle, vice president Barrett Co. (large manufacturers of roofing, building paper, and so on), Boston, Mass.

M. B. Kelly, president American Steel Co., Park Building, Pittsburgh, Pa. (April 20, 1920.)

C. B. Van Dusen, vice president S. S. Kresge Co.; Detroit, Mich. (Gross sales in 1920 were $51,245,000.

Carbondale Machine Co., 1325 Manhattan Building, Chicago, Ill.

Ruud Manufacturing Co. (large manufacturers of heaters, and so on), Pittsburgh, Pa.

Runkel Bros. (chocolate and cocoa), through M. Fieux, secretary, New York City. (February 1, 1921.)

Dalton Adding Machine Co., through James L. Dalton, president, Cincinnati, Ohio.

Charles B. Stretch, director and general manager of Everlastik Corporation (rubber textiles manufacturers), New York City.

J. D. Dort, president Dort Motor Car Co., Flint, Mich.

Globe-Wernicke Co., Cincinnati, Ohio.

Bond Foundry & Machine Co., through M. T. Williams, managing director; Manheim, Pa.

Pierce, Butler & Pierce Manufacturing Corporation (manufacturers of steam and water boilers, and so on), through C. F. Bennett, secretary, New York City.

John L. Whiting-J. J. Adams Co., Boston, Mass.; manufacturers of Whiting-Adams Brushes; brush manufacturers for over 112 years and the largest in the world. (Employ metric units extensively.)

D. Auerbach & Sons (large candy manufacturers), New York City.

Anglo-American Mill Co., through L. F. Little, president, Owensboro, Ky.

Douglas Fairbanks Pictures Corporation, through J. Fairbanks, Hollywood, Calif.

Louis A. Riley, president, Lehigh & Hudson River Railway, Philadelphia, Pa.

Charles A. Schieren Co. (large tanners and manufacturers of belting), through Jay Zeamer, New York City.

Los Angeles Soap Co. (large manufacturers), through C. B. Bergin, vice president, Los Angeles, Calif.

Littauer Bros. (glove manufacturers), New York City.

Chess & Wymond Co. (large manufacturers of staves, and so on), through W. Avery, Louisville, Ky.

Mershon, Eddy, Parker Co. (manufacturers of doors, window frames, and so on), through A. H. Hempstead, president, Saginaw, Mich.

Dayton Steel Foundry Co., through P. W. Klinger, chief engineer, Dayton, Ohio.

Borden Co. (manufacturers of "Beaver Quality Tools"), through A. F. Howe, vice president.

Holland-St. Louis Sugar Co. (manufacturers of granulated sugar), through W. Kremers, superintendent, Decatur, Ind.

Sterling Products Co. (large canners), through C. F. Hartmetz, president, Evansville, Ind.

Diamond Chain & Manufacturing Co., through G. M. Bartlett, chief engineer, Indianapolis, Ind.

American Zinc Products Co., through C. W. Martin, president, Greencastle, Ind.

Federal Rubber Co., through J. M. Tait, assistant treasurer, Cudahy, Wis.

Wadhams Oil Co., through E. N. Kullman, treasurer, Milwaukee, Wis.

Western Grip and Trunk Co. (manufacturers of luggage), through F. Stockhome, secretary-treasurer, Milwaukee, Wis.

L. C. Smith & Bros, Typewriter Co., Syracuse, N. Y.

Jewett & Sherman Co. (importers and manufacturers of coffees, teas, spices, and so on). through Lewis Sherman, president, Milwaukee, Wis.

Fuller-Warrent Co. (mahufacturers of stoves, and so on), through C. McCullough, secretary, Milwaukee, Wis.

Cereal Products Co. (large manufacturers), through F. A. Miller, general manager, Manitowoc, Wis.

Pacific Car & Foundry Co. (large builders of standard railway equipment and supplies), through O. D. Colvin, vice president and general manager, Seattle, Wash.

E. H. Long, district superintendent of plant, Pacific Telephone & Telegraph Co., Oakland, Calif.

Paul Shoup, vice president, Southern Pacific Railroad Co.; president, Pacific Oil Co., San Francisco, Calif.

E. G. Burkland, president, N. Y., N. H. & H. R. R. Co., New Haven, Conn.

Hammond Typewriter Co., New York City.

E. Kaufman & Co. (steel manufacturers), New York City.

W. H. Olin, supervisor, Denver & Rio Grande Railroad, Denver, Colo.

Inland Machine Works (manufacturers of machine tools), St. Louis, Mo.

The Pompeian Company, Cleveland, Ohio.

Burroughs Adding Machine Co.

The following is an alphabetical list of manufacturers and merchants, typical of the many thousands who urge gradual metric standardization. It is taken mainly from World Trade Club booklet 4, Who Urge Meter-Liter-Gram?

Accurameter Manufacturing Co., Dr. F. Reichman, president, St. Louis, Mo.

Acme Packing Co., Chicago, Ill.

Adams Axle Co., Findlay, Ohio, G. M. Carter, president.

Adams Seed Co., W. C. Adams, treasurer, Decorah, Iowa.

Air-O-Flex Automobile Corporation, Detroit, Mich.

Alberto de Verastegui, managing director of export, Babcock & Wilcox Co., New York City.

Alco Automatic Light Co., J. A. Hillstrom, V. P., Minneapolis, Minn.

All Package Grocery Co., Woolworth Building, New York City.

Allen & Lewis, Portland, Oreg.

Alexander Brothers (Inc.), Philadelphia, Pa.

Alvah Bushnell Co., Philadelphia, Pa.

American Can Co., New York City.

American Chemical & Manufacturing Co., Norfolk, Va.

American Machinery Syndicate, New York City, N. Y.

American Manufacturing Concern, New York City.

American Pressweld Radiator Corporation of Michigan, Detroit, Mich., J. A. Irwin, general manager.

American Swiss Finish Co., Providence, R. I.

American Valve and Tank Co., Fairmont, W. Va.

J. K. Amoury, J. K. Amoury & Son, New York City.

Anderson Electric Specialty Co., Chicago.

Anderson Manufacturing Co., Des Moines, Iowa.
Antiseptic Products Co., Denver, Colo.
Apothecaries Hall Co., Waterbury, Conn.
John T. Ardis, Finance Committee, General Motor Corporation, Wilmington, Del.
Art Urn Co., Brooklyn, N. Y.
Atlantic Utility Works, East Point, Ga.
Atlas Roofing Co., New Burgh, N. Y.
W. Atlee Burpee Co., Philadelphia, Pa.
Austin Nichols & Co., Brooklyn, N. Y.
C. E. Ayre, Avalon, Calif.
Alpha Portland Cement Co., Easton, Pa.
American Saw Mill Machinery Co., Hackettstown, N. J.
American Trading Co. of Cuba, Havana, Cuba.
American Watch Case Co. (Inc.), New York City.
C. L. Bailey Grocery Co., Marietta, Ohio.
Baltimore Car Wheel Co., Baltimore, Md., J. Paul Baker, president.
Barley Motor Car Co. (manufacturers of the Roamer), Kalamazoo, Mich., C. E. Stephenson, secretary.
Barnes and Tibbitts Shipbuilding and Dry Dock Co., Alameda, Calif., W. S. Tibbitts, president.
Bayer Co. (Inc.), New York City.
Belle Meade Farms, Belle Meade, Va.
Bemis Bros. Bag Co., Houston, Tex.
Luigi Berardo, New York City.
Blakeslee, D. W., Pennsylvania Electric & Manufacturing Co., Irwin, Pa.
Blatchford Calf Meal Co., Waukegan, Ill.
Bonner Mercantile Co., Deer Lodge, Mont.
Boston Woven Hose & Rubber Co., Boston, Mass.
Braun Corporation, Los Angeles, Calif.
The Breakers, Atlantic City, N. J., Joel Hillman, president.
The Bronzo Aluminum Corporation, J. E. Kauffmann, president, Buffalo, N. Y.
Martin Brotherson, manager, Haffer Supply Co., jobbers and distributors, Joplin, Mo.
John W. Brown, president, Cleveland Electric Metals Co., Cleveland, Ohio.
Brunswick-Balke-Collender Co., New York City.
J. P. Barnes, general manager, Schenectady Railway Co., New York City.
The Bearings Co. of America, Lancaster, Pa.
Best-Clymer Manufacturing Co., St. Louis, Mo.
A. C. Basselman & Co., New York City.
California Wholesale Grocery Co., Los Angeles, Calif.
Campbell Holton & Co., wholesale grocers, Bloomington, Ill.
Canton Art Metal Co., Canton, Ohio.
Louis B. Caproni, M. Gurney & Sons (Inc.), Oneonta, N. Y.
W. C. Carey, Iroquois Natural Gas Co., Buffalo, N. Y.
Carlton Consolidated Lumber Co.
Carrollton Excelsior & Fuel Co. (Ltd.), New Orleans, La.
R. E. Case, care the International Nickel Co., New York City.
Celite Products Co., New York.
Chain-O-Spark Corporation, president, W. G. Calderwood, Minneapolis, Minn.
Champion Chemical Co., Springfield, Ohio.
Channel Commercial Co., Los Angeles, Calif.
Chicago Varnish Co., Chicago, Ill.
Cleveland Electric Metals Co., Cleveland, Ohio.
Cleveland Metal Products Co., Cleveland, Ohio.
E. A. Dodd, vice president; Palmer Clingman, the Sperry Gyroscope Co., Brooklyn, N. Y.
Closset & Devers, Portland, Oreg.
Collier Keyworth Co., Gardner, Mass.
Columbus Handle & Tool Co., Columbus, Ind.
Cook Paint & Varnish Co., Kansas City, Mo.
W. Dewey Cooke, secretary and sales manager, Southern Fertilizer & Chemical Co., Savannah, Ga.
Consolidated Lumber Co., Manistique, Mich.; Leo. C. Harmon, vice-president.
The County Agent & Farm Bureau, Chicago, Ill.
Cuba-Americas Mercantile Co. (Inc.), New York City, through J. M. Walsh, vice president.

Curd & Blakemore Co., Louisville, Ky., through Marcus Blakemore.
Chicago Mirror and Art Glass Co., Chicago, Ill.
C. A. Colman Co., New York City.
Dairy Cream Separator Co., Lebanon, Ind; James K. Risk, treasurer.
A. R. Danagh, of Haworth & Dewhurst (Ltd.), wholesale grocers, Pittsburg, Pa.
Davies Arjay, Easton, Pa., president of Tombler Grocery Co.
W. B. Davis & Co., Aurora, Ill.
Delta Mercantile Co., El Centro, Calif.
Demen Bros. Co., grain dealers, Walla Walla, Wash.
Detroit Motor Parts Co., Detroit, Mich; F. M. Keeton, vice president.
Detroit Stove Works, East Detroit, Mich.
A. Deutz & Bro., jobbers and exporters of hardware, Laredo, Tex.
Dexter Portland Cement Co., New York City.
De Zeng Standard Co., Camden, N. J.
Ed. L. Dithridge, Germain Seed & Plant Co., Los Angeles.
Henry L. Doherty & Co., Toledo, Ohio.
Domestic Mills Paper Co., New York City.
D. M. Donnan, president and manager, Electrical Engineering & Manufacturing Co., Pittsburgh, Pa.
David Dows, president American Grondal Co., New York City.
Drake & Co., wholesale grocers, Easton, Pa.
Duluth Shipbuilding Co., Duluth, Minn.
Dunbar-Dukate Co., New Orleans, La.
C. A. Dunham Co., Marshalltown, Iowa, through A. R. Welker, manager finance and accounts.
Duquesne Oil & Supply Co., Pittsburgh, Pa.
Chas. D. Durkee & Co., 2 and 3 South Street, New York City, through P. F. Wiese, secretary.
Edward L. Davis Lumber Co., Louisville, Ky.
A. De Prima Co., Inc., New York City.
Thomas C. Desmond, president, Newburgh Shipyards (Inc.), New York City.
Ebrey Chemical Works, Humacao, Porto Rico.
Echeguren & Co., San Francisco, Calif.
Eclipse Valve Grinder Co., Kansas City, Mo.
Ederheimer Stein Co., Chicago, Ill.
Clarence E. Edson, Cleveland, Ohio.
Eimer & Amend, New York City, through A. O. Eimer, assistant treasurer.
Electric Smelting & Aluminum Co., Sewaren, N. J., through Alfred H. Cowles, president.
Electric Supply & Equipment Co., Hartford, Conn., through H. E. Page, president.
W. E. Ellis Co., Haverhill, Mass.
Ernest O. Engstrom, president, Marcy Co., Boston, Mass.
Easton Car & Construction Co., Easton, Pa.
Economy Drawing Table & Manufacturing Co., Adrian, Mich.
Ellis Adding-Typewriter Co., Newark, N. J.
Falcon Packing Co., New York City.
Fansteel Products Co. (Inc.), North Chicago, Ill.
C. W. Ferguson Collar Co., Troy, N. Y.
Ferracute Machine Co., Bridgeton, Pa.
Field Force Pump Co., Elmira, N. Y.
J. Logan Fitts, Warren Webster & Co., Camden, N. J.
Flaketown Graphite Co., Mountain Creek, Ala.
Fleetwood Metal Body Co., Fleetwood, Pa., through N. J. Kutz, purchasing agent.
Foley Fertilizer Co., Foley, Ala.
M. Furuya Co., Seattle, Wash., importers and exporters, Japanese and American.
J. A. Flemer, merchant, Westmoreland County, Va.
Foss Islands Tannery, York, Pa.
Garhart Dental Specialty Co., Malden, Mass.
Edmund Garrigues, chief engineer of Russell & Co., manufacturers of machinery, Massillon, Ohio.
Geier & Bluhm, Troy, N. Y., through James Geier, manager.
Gem Paper Box Co., New York City.
General Petroleum Corporation, Los Angeles, Calif.

German Press & Plate Co., Cleveland, Ohio.
Gibson Mandolin-Guitar Co., Kalamazoo, Mich.
Gifford Engine Co., Lansing, Mich.
Glogan & Co., Chicago, Ill.
S. M. Gloyd, lumber dealer, Oklahoma City, Okla.
Goddard Grocery Co., St. Louis, Mo.
Greenbaum Bros. (Inc.), Seaford, Del.
S. J. Griffin, Blackman & Griffin Co., wholesale grocers, Ogden, Utah.
Griswold Motor & Body Co., Detroit, Mich.
Groneweg & Schoentgen, Council Bluffs, Iowa.
Grover-Stewart Drug Co., Jacksonville, Fla.
Haas Bros., San Francisco, Calif.
Hagen, Ratcliff & Co., Huntington, W. Va.
M. D. Haire, Wickes Bros., Seattle, Wash.
Hall Brothers Co., Lincoln, Nebr.
Hall, Luhrs & Co., Sacramento, Calif.
W. H. Hammer, Hammer & Co., San Francisco.
Charles H. Harding, of Erben Harding & Co., manufacturers of textiles, Philadelphia, Pa.
George W. Hartzell, Piqua, Ohio.
Haas, Baruch & Co., Los Angeles, Calif.
Henrici Laundry Machinery Co., Boston, Mass., through F. Henrici, works manager.
Wilwyn Herbert, director, Everlastic (Inc.), New York City.
Ernest M. Hill, secretary and treasurer, Ellicott Square Co., Buffalo, N. Y.
Holbrook Manufacturing Co., Jersey City, N. J.
Holmes & Herrick Lumber Co., Gulfport, Miss.
E. Clemens Horst Co., San Francisco, Calif.
Hotchkiss, Blue & Co., Chicago, Ill.
J. W. Hudson, Ukiah, Calif.
Huntington Wholesale Grocery Co., Huntington, W. Va.
Hygienic Products Co., Canton, Ohio.
Haenichen Bros. Silk Co., Paterson, N. J.
Charles Harding, president Harding Cream Co., Omaha, Nebr.
Clarence Hodson & Co., New York City.
Holliston Mills, Norwood, Mass.
Hypotheck Mining and Milling Co., Wallace, Idaho.
H. B. Ibson, Gemco Manufacturing Co., Milwaukee.
Ilg Electric Ventilating Co., Chicago, Ill.; New York, Cleveland, Philadelphia, Pittsburgh, Boston, Detroit.
Illinois Smelting and Refining Co., Chicago, Ill.
Imperial Machine Co., Minneapolis, Minn.
Independent Cork Co. (Inc.), Brooklyn, N. Y.
Indicating Calipers Co., New York City, through Charles H. B. Stepanek, manager.
Industrial Cotton Oil Properties, Houston, Tex., through W. P. Beaumont, general manager.
Industrial Materials Co. (Inc.), New York City.
Intercontinental Rubber Co., 15 Exchange Place, Jersey City, N. J., through G. H. Carnahan. president.
International Chemical Co., Camden, N. J.
International Exporting & Importing Corporation.
International Trade Developer.
C. S. Jacob, Chas. W. Jacob & Allison, New York City.
Carl P. Johnson, president, Johnson, Read & Co., Chicago, Ill.
J. Ralph Jones, National Mosaic Tile Co., Mobile, Ala.
Judson Freight Forwarding Company, Chicago, Ill.
Judson Grocery Co., Grand Rapids, Mich.
Victor E. Karminski & Co. (Inc.), New York City.
George D. Kirby, assistant secretary, United States Beet Seed Co., Idaho Falls, Idaho.
Kneipp Malt Food Co., Manitowoc, Wis.
Koenig Medicine Co., Chicago, Ill.
H. W. Koster, The Koster Co., San Francisco.
A. S. Krebs, The Krebs Pigment & Chemical Co., Newport, Del.
Dr. George Frederick Kunz, Tiffany's, New York City.
The Lagonda Manufacturing Co., Philadelphia, Pa.

Brown Landone, Bragant, Sunnyside, Long Island, N. Y.
R. A. Leet, secretary, Bowman Drug Co., Oakland, Calif.
H. Lieber & Co., New York.
Lockhart Spiral Service Leggings (Inc.), Brooklyn, N. Y.
John Lonke, Bellwood Trading Corporation, New York City.
The Lord Baltimore Press, Baltimore, Md.
Los Angeles Valve & Fitting Co., Los Angeles.
D. B. Loveman Co., Chattanooga, Tenn.
David Lupton's Sons Co., Philadelphia, Pa.
Geo. L. Mackay, Struthers-Wells Co., Warren, Pa.
Chas. A. Magill, treasurer, Johnston & Larimer Dry Goods Co., Wichita, Kans.
Manufacturers' Trading Corporation, Boston, Mass.
Marcy Co., manufacturing chemists, Boston, Mass.
Maryland Glass Corporation, Baltimore, Md.
Mason-Perkins Paper Corporation, Bristol, N. H.
Master Rule Manufacturing Co. (Inc.), New York City, through C. M. Nicholson, president.
Mathews Gravity Carrier Co., Ellwood City, Pa.
Mayor Coating Machines Co., Rochester, N. Y.
G. B. McBreen, president, Mechanical & Electrical Manufacturing Co., Chicago, Ill.
McKeen Motor Car Co., Omaha, Nebr., through W. R. McKeen, president.
T. H. B. McKnight, treasurer, Pennsylvania Lines west of Pittsburgh, Pittsburgh, Pa.
Mediterranean Trading Co., New York.
Mendleson Corporation, New York City.
Menzel & Co., New York City.
Merrell Chemical Co., Cincinnati, Ohio.
Merrell Drug Co., St. Louis, Mo.
Michigan Drug Co., Detroit, Mich.
Chas. N. Mikels, Indianapolis, Ind.
Milwaukee Bedding Co., Milwaukee, Wis.
Minneapolis Drug Co., Minneapolis, Minn.
Minute Tapioca Co., Orange, Mass.
Moreland Motor Truck Co., Los Angeles, Calif., through Watt L. Moreland, general manager.
Mueller-Metzner Co., realtors, Louisville, Ky.
Myerstown Foundry & Manufacturing Co., Myerstown, Pa.
McCoy-Linn Iron Co., Milesburg, Pa.
McIntire, Magee & Brown Co., Philadelphia, Pa.
F. W. Miller Heating Co., Chicago, Ill.
Mossberg Pressed Steel Corporation, Attleboro, Mass.
Nashua Lumber Co., Nashua, Minn.
National Audiphone Co., New York City.
National Grocery Co., Detroit, Mich.
Nebraska Independent Oil Co., Norfolk, Nebr.
Neuman & Schwiers Co., New York City.
The New England Granite Works, Westerly, R. I.
Carl Norgren, assistant manager of sales, district of Seattle, for the Chicago Pneumatic Tool Co., Chicago, Ill.
Nilson Die & Tool Co., Chicago, Ill.
New Jersey Machine Corporation, Hoboken, N. J.
Obispo Rubber Plantation Co., New York.
Robt. R. Odell, Minneapolis, Minn.
Ohio Galvanizing & Machine Co.
Oklahoma Petroleum and Gasoline Company, Tulsa, Oklahoma.
Oliver-Finnie Co., Memphis, Tenn.
Oppenheimer Casing Co., Chicago, Ill.
Alfred F. Osborn, Manufacturers' Export Agent, New York City.
Oshkosh Excelsior Manufacturing Co., Oshkosh, Wis.
Otto Weiss Milling Co., Wichita, Kansas, thru W. W. Weiss, Secretary.
Pacific Coast Shipbuilding Co., San Francisco.
E. C. Palmer & Co. (Ltd.), New Orleans, La.
Ray Palmer, President, New York and Queens Electric Light and Power Co., City of New York, Long Island City.
W. F. Parish, Technical Director, Sinclair Refining Co., Chicago, Ill.
Chas. G. Park, American Linen Supply Co., Chicago, Ill.

Parsons Paper Company, Holyoke, Mass.
F. L. Payne, Decorator, Wichita, Kansas.
Peerless Biscuit Co., Pittsburgh, Pa.
Peerless Color Co., Bound Brook, N. J.
W. E. Peirce & Co., Milford, N. H.
Pennsylvania Steel & Iron Corporation, Lancaster, Pa.
Peterson Co., Frank B., San Francisco, Calif.
Pittsburgh Electric & Machinery Works, Pittsburgh, Pa.
Plomb Tool Manufacturing Co., Los Angeles, Calif.
Plumbing & Mill Supply Co. (Inc.), H. J. Veith, president and manager. New Orleans, La.
R. W. Poindexter, jr., Poindexter & Co., Los Angeles.
P. J. Pauly, jr., president, Pauly Jail Building Co., St. Louis, Mo.
Harold L. Perrin, jeweler and optometrist, Sargent, Nebr.
M. C. Peters Mill Co., Omaha, Nebr.
Pillsbury Flour Mills Co., Minneapolis, Minn.
Pomeroy Salt Assn. Co., Pomeroy, Ohio.
Porter Chemical Co., Hagerstown, Maryland.
Portable Machinery Co., Passaic, N. J.
Radium Chemical Co., Pittsburgh, Pa.
William Rahr Sons' Co., Manitowoc, Wis.
Raisin & Zaruba, San Francisco, California.
Frank E. Randall, Waltham, Mass.
Raymond Concrete Pile Co., New York City.
Reckitts, (Ltd), Blue Manufacturers, New Brunswick, New Jersey.
Dr. Fritz Reichmann, Measuregraph Co., St. Louis, Mo.
T. B. Rice & Sons Co., Philadelphia, Pa.
Edro Richardson Brass Co., Baltimore, Md.
Richardton Milling Co., Richardton, N. Dak.
E. T. Richmond & Co., Bradford, England.
Fr. Loes Riedel & Co., New York City.
Roberts Cone Manufacturing Co., St. Joseph, Mo.
Roessler & Hasslacher Chemical Co., Perth Amboy, N. J.
Rome Universal Export Co., Inc., thru Calvin Martin, President, Rome, N. Y.
Romeo & Co., (Inc.), New York City.
Rosco Trading Co., New York City.
L. Rosenstern Dry Goods Co., Tucson, Arizona.
Rumford Chemical Works, Providence, R. I.
Safety Fire Extinguisher Co., New York City.
St. Louis Button Co., St. Louis, Mo.
Santa Rosa Mercantile Co., Santa Rosa, N. Mex.
Colonel Wm. Jay Schieffelin, President, Schieffelin & Co., New York City.
A. R. Schmidt Electric Co., Milwaukee, Wis.
Chas. Schoolhouse & Son, New York.
Sedgwick Machine Works, 150 West 15th Street, New York City, through J. I. Wakelee, President.
A. M. Selikowitz, care Tapper & Selikowitz (Inc.), exporters and importers, 26 Cortlandt St., N. Y.
Scranton Stove Works, Scranton, Pa.
Seacoast Canning Co., New York City.
H. H. Sherwood, President, Sherwood Company, San Francisco.
F. A. Shipley Co., Santa Paula, Calif.
Shipman & Welch, General Contractors, Philipsburg, Pa.
Sinclair Refining Co., Chicago, Ill.
Sloan Electric Co., Santa Fe, New Mexico.
Southern Ohio Coal Exchange, Columbus, Ohio.
Southern Steel Co., San Antonio, Texas.
Splitdorf Electrical Co., 98 Warren Street, Newark, N. J., thru H. E. Borger, Engineer.
Standard Chemical Manufacturing Co., Omaha.
Standard Construction Engineering and Supply Co., Philadelphia, Pa.
Standard Rice Co., Inc., Houston, Texas.
Standard Sanitary Mfg. Company, Pittsburgh, Pa., thru Theo Ahrens, President.
Stewart Manufacturing Co., Waterloo, Iowa.
Stromberg Electric Company, Chicago, Ill., thru R. E. Cornelison.
Struthers-Wells Co., Warren, Pa.

Superior Laboratories, Mfg. Chemists, Grand Rapids, Mich.
Sussman, Wormser & Co., San Francisco, Calif.
Sweet, William L., Rumford Chemical Works, Providence, R. I.
Spreckels Bros. Commercial Co. (dealers in cement, wood, coal, etc.), San Diego, Calif.
C. D. Soule, Customs House Broker, Sumas, Washington.
Edward P. Stahel & Co., New York City.
W. O. Talcott, of W. O. & M. W. Talcott, Makers of Belt Hooks, Providence, Rhode Island.
Taylor-Wharton Co., Easton, Pa.
Temple Candy Co., Temple, Texas.
Texas Carnegie Steel Association, thru C. N. Markle, President.
Tharinger Macaroni Co., Milwaukee, Wis.
Thompson-Katz Lumber Co., Memphis, Tenn.
J. M. Thorburn & Co., New York.
A. J. Todd, A. M. Todd Co., Kalamazoo, Mich.
F. J. Townsend, Painted Post, N. Y.
Turner Tool Manufacturing Co., Birmingham, England.
Tuxbury Oil and Refining Corp., Henry C. Tuxbury, President, New York City.
Underwood & Underwood, New York City.
Union Electric Manufacturing Co., Milwaukee, Wisconsin.
United Electric Apparatus Co., Boston, Mass.
United Wholesale Grocery Co., Los Angeles, Calif.
Universal Machine Co., Bowling Green, Ohio.
United States Smelting Furnace Co., Belleville, Ill.
Van Guilder Construction Co., Rochester, N. Y.
Veeder Manufacturing Co., Hartford, Conn.
Vera Chemical Co., North Milwaukee, Wis.
Voss Alcohol Export Corporation, New York City.
J. M. Walsh, vice president, Cuba-Americas Mercantile Co. (Inc.), New York City.
Warner Jewelry Case Co., Buffalo, N. Y.
J. Weller Co., Oak Harbor, Ohio.
Wellman, Peck & Co., San Francisco, Calif.
Wenger Milling Co., Dayton, Ohio.
Fred Wetzel, importer and exporter, dyestuffs, chemicals, and pharmaceutical products, 131 East Twenty-third Street, New York.
Western Chemical Manufacturing Co., Denver, Colo.
West Virginia Coal Co., Richmond, Va., through E. S. Simpson, president.
Western Wholesale Drug Co., Los Angeles, Calif.
Wilcox, Ives & Co., Savannah, Ga.
Wildberg Bros., San Francisco, Cal.
John R. Wiley & Co., wholesale and retail druggists, Trenton, N. J.
A. P. Williams, R. C. Williams & Co., New York City.
Samuel H. Williams, The J. B. Williams Co., Glastonbury, Conn.
Winder & Dean, El Paso, Tex.
Wood, Iron & Steel Co., Philadelphia, Pa.
J. M. Walshe, General Superintendent, American Schrubbing Equipment Co., Hannibal, Mo.
World Trade Co., New York City.
E. J. Yetter, president, Western Elaterite Roofing Co., Denver, Colo.
Youroveta Home & Foreign Trade Co. (Inc.), New York City.

ENGINEERS, ARCHITECTS, AND ACCOUNTANTS.

John A. Brashear, president, American Society of Mechanical engineers, 1914-15; manufacturer of astronomical and physical instruments; Pittsburgh, Pa. (May 30, 1919): "I have been fighting for the metric system for 40 years and intend to do so until I have no further use for weights and measures."

Vladimir Karapetoff, consulting engineer, professor of electrical engineering. Cornell Univerisity, Ithaca, N. Y.: "I wish all success to the valiant fight in the interest of the metric system."

J. W. Noakler, C. E. and M. E., East Worcester, N. Y.: "As a graduate of the Academy of Science of France I was trained in the metric system and have always used it."

Charles H. Hughes, engineer; author of Hughes's Handbook of Ship Calculations, Construction, and Operation (April 20, 1919): "I agree with the World Trade Club in regard to the metric system."

Joseph E. Camatte, mechanical, electrical, and consulting engineer; Tulane University, Atlalta, La.: "It is a great pleasure for me to indorse such a move; as a technical man, of course, I am in favor of metric standardization."

J. Y. Hartman, electrical engineer, American Sugar Refining Co., New Orleans, La.: "The metric system idea has my hearty indorsement. There has never been, to my mind, a reasonable argument against it."

Robert H. Engle, metallurgical engineer, Clarksburg, W. Va.; Engle Metal-Distillation Furnace: "I have for many years been a very strong advocate of the decimal and sincerely hope that I will live long enough to see it become entirely universal."

F. C. Heylman, mechanical engineer; Martinez, Calif.: "I am extremely gratified at the movement to convert this county to the use of metric units, the advantages of which have been so universally recognized as to be taken for granted."

A. Chistianson, chief engineer, Standard Steel Car Co. (November 25, 1921): "I am very much in favor of the adoption of the metric system. The Standard Steel Car Co. are getting considerable amount of export business, and it all (or a greater part of it) has to be done in the metric system."

A. E. Kennelly, electrical engineer; American exchange engineering professor in France, 1922: "Large amounts of time and effort are wasted perennially in North America, on the cumbersome units of weights and measures in the customary English system. There are some 45 units of measure in the tables of that system; and there are certain serious ambiguities in the meanings of those units. A scientific paper written in nonmetric units is not a world paper, but a sectional paper." (In Research in Engineering Colleges, University of Toronto Press, 1921. See also numerous other citations from this authority.)

P. G. Zwilgmeyer, engineer; Northern Pacific headquarters, Tacoma, Wash.: "If there is any one subject that is of greater practical importance to the professional engineer than that of exact measurement, I am free to confess that I have never met with it. The metric system of weights and measures has the same advantage over the older systems as has the so-called Arabic (or rather Hindoo) notation, or decimal system, over those of classical antiquity. Adoption of the metric system is one of the steps that will have to be taken before our great country can fulfill its destiny and become a leader among nations." (From address delivered before the Tacoma Chapter, American Association of Engineers, March 5, 1920. This organization at that time passed strong resolutions calling upon the United States Congress to establish gradual metric standardization.)

W. A. Silliman, Altoona, Pa. (March 5, 1920): "If it were left to the mining and civil engineers, we would very quickly be on a decimal system, the only hindrance to the metric units being the fact that so many old records are on the former units. That this latter is a matter of small consequence is shown by the fact that mining and civil engineers consider it no hardship to have to translate rods, perches, yards, and inches into feet and decimals of a foot. I hope to see the time when we can dispense with inches altogether."

Mr. F. L. Olmstead, landscape architect, Brookline, Mass. (March 5, 1920): "I am convinced of the desirability of bringing about the general use of the metric system in the United States."

J. Ashton, engineer, Pittsburgh, Pa. (March 29, 1920): "In my opinion the metric system of weights and measures should greatly reduce mistakes, misunderstandings, and miscalculations."

Charles W. Lang, consulting engineer, New York City (March 6, 1920): "The worthy effort to cause universal use of the meter-liter-gram standards of quantity is indeed commendable. The writer has long been converted to this modern sensible system and will gladly use all reasonable diligence to assist the noble cause."

Comfort A. Adams, consulting electrical engineer and dean of Harvard University Engineering School, in article on "Engineering and industrial standardization" in the Journal of Electricity, November, 1919: "Nearly all European nations as well as the Latin-American nations have adopted the rational metric system, whereas the English-speaking nations still cling to the English system with its confusion of oddly related weights and measures. However, since the electrical and magnetic units are the same the world over, since they

are based upon the metric system, and since practically all scientific work is handled by that system, a vast amount of time is wasted by the English-speaking nations, not only by the necessity of becoming familiar with both systems, but also in their use due to the frequent necessity of transformations from one to the other. This latter loss is particularly serious in the field of electrical engineering."

Thomas Corwin Mendenhall, of the United States Geodetic Survey, before the engineers' societies, said of meter-liter-gram: "These units are bound to come into universal use in the near future. The prodigious advantages attainable through their simplicity, economy, and uniformity assure their world-wide use."

Hobart B. Upjohn, M. E. A. J. A., architect. New York City (May 27, 1919): "I wish to place myself on record as being heartily in favor of the adoption of the metric system in this country. Anything that I can do to assist in its adoption I shall be very glad to do. I consider our present system as highly expensive. As an architect I receive surveys laid out to scale of tenths of an inch. It is necessary to transform these surveys to our own scales, thereby running a risk of error. I believe the number of errors made through just the misunderstanding of the one item 1′ 0″ and 10″ has cost the general public annually in this country untold amounts of money. I believe the adoption of the metric system by the engineers, architects, and manufacturers would eliminate numberless errors, which only those in practice realize and of which nobody knows accurately the actual cost."

Edward C. Newcomb, consulting engineer for the Wright-Martin Aircraft Corporation, New Brunswick, N. J. (June 11, 1919): "Before the international standardization of automotive parts or of any line of material can be successfully carried out, the standard of measurement used must be the same in all countries. hence I indorse legislation that will bring about the exclusive use of meter-liter-gram by the United States of America."

F. J. Walsh, consulting engineer of the Port of Tacoma, Wash. (July 9, 1919): "I am glad to do my bit toward the furtherance of this great international movement. which I believe will not only promote industrial harmony and economy, but will advance the cause of a permanent, world-wide peace. Incidentally, I may say I am glad to see that San Francisco is in the forefront in this, as in many other movements for the benefit of humanity and the promotion of commerce."

Charles W. Dawson, architect, member of American Institute of Architects. Society of Technology, British Fire Prevention Committee, National Fire Protection Association, Muskogee, Okla. (June 10, 1919): "I am most heartily in favor of the adoption of the metric system in this country. In my profession we have to use that system in connection with many phases of our work, but we are still burdened by the unrelated, cumbersome, and obsolete systems of measurement which still obtain in the calculation of land, of stone, of products sold by the pound, and all things reckoned by feet and inches. It seem ridiculous that we should burden ourselves in this way; should continue to teach our children such ancient methods, and should go on handicapping our Nation, not only in its everyday life, but in its dealings with the rest of the world. I can not too strongly urge that you favor the adoption of the meter-liter-gram as the official system of measurement in the United States of America."

Joseph F. Merrill, director, schools of mines and engineering, University of Utah, before the standardization conference, American Mining Congress, Denver, Colo.: "The system of weights and measures in current use in the United States is cumbersome, complicated, and unscientific. It is a medley, a jumble. Its use impedes progress, wastes hundreds of millions of dollars annually, and hampers the commerce of the country, especially the world commerce.

"Why not now adopt the metric system in the United States? Some few fear that this would mean a loss to them. But under gradual metric standardization no part of any manufacturing plant shall be scrapped until completely worn out. Every existing size may continue indefinitely to be used, but after a definite date, sizes, will be described in metric language units, everywhere used, everywhere understood.

"Simplicity results in economy; the adoption of the simple metric system by the United States will result in an enormous annual saving of time, which expressed in terms of money will run into many hundreds of millions of dollars. Furthermore, the use of the metric system by us will extend our friendly trade relations and be a powerful means of promoting world progress and peace."

Fred J. Miller, former president, American Society of Mechanical Engineers (1920); member, Herbert Hoover's committee on the elimination of waste in industry, American Engineering Council, former editor, American Machinst: Manufacturers opposing the adoption of metric weights and measures in the United States of America are subject to an illusion. This opposition arises from a concentrated and long continued effort to convince them that the adoption of the metric system would mean a great pecuniary loss for them. This has resulted in the organization of an association the sole object of which is to maintain this illusion. Such an erroneous impression should be corrected."

Ernst & Ernst, audits and systems (19 branch offices), through F. H. Figsley, New York City: "We are eager and ready to give our unqualified support to any movement that will further the ends of the metric standardization work which the World Trade Club has undertaken."

Rosenberry, Gunther & Breyer, business engineers, Cleveland, Ohio: "We shall do all we can to further the meter-liter-fram project."

P. H. Hessol, cost accountant for the American Druggists' Syndicate, New York (May 27, 1919): "I want to go on record as being heartily in favor of adopting the exclusive use of the meter-liter-gram, or the metric system, in place of the system presently in use in this country. I sincerely believe that it will be of inestimable value in every business and I know it would help us greatly in ours. In cost-account work we have a voluminous number of intricate calculations which are frequently made difficult, and unnecessarily so, by reason of the use of our present system. I can not understand how anybody doing any kind of figuring can be opposed to this movement."

Roger W. Babson, president, Babson Statistical Organization, Boston, Mass. (March 16, 1921): "I am convinced that the gradual adoption of the metric system of weights and measures is best for the United States of America. We live in a scientific age where we do things better than formerly. The world is moving on, and we must not stand still in so vital a field as measurement, for measurement is the master art which leads all arts and crafts, all industry and commerce, all finance and statistics, and now in all legislation.

"The United States of America must take its place with the other nations of the world which have already abandoned their old system of weights and measures as the legal standard, and set up a new international decimal system of weights and measures of the highest scientific and practical efficiency."

C. E. Ayre, Avalon, Calif. (August 16, 1919): "Many thanks for your folder and blanks relative to the movement for sinking and dynamiting the thumb and elbow and tin-pot method of measuring and weighing. I am a member of the American Appraisal Co., and this question of meter-liter-gram is one that touches us very closely. We have a staff of something like 400 people juggling with this mess of figures 8 hours a day." (Letter to World Trade Club.)

Among the other engineers, quoted elsewhere in this book, who urge gradual metric standardization are John Hays Hammond, Comfort A. Adams, Arthur E. Kennelly, Thomas Edison, Hudson Maxim, Theodore H. Miller, Howard Richards, Frank G. Bolles, David Molitor, R. C. Bailey, Alexander Graham Bell, S. J. Macfarren, Arthur Bessey Smith, F. W. Andrew, Burgess Darrow, Clancey M. Lewis, O. L. Lewis, Col. Thos. H. Rees, and many others, especially many quoted in the Manufacturers List. (Consult index.)

Included in the thousands of engineers, architects, and accountants working for the metric units are the following:

Charles P. Steinmetz, consulting engineer, General Electric Co., Schenectady, N. Y.

Charles Paget, of Purnell & Paget, architects, civil and mining engineers, Canton, China.

Charles W. Merrill, metallurgist, San Francisco, Calif.

R. H. Halpenny, Electrical engineer, Southern Sierras Power Co., Riverside, Calif.

G. W. Gail, jr., mechanical engineer, Clover Hill Road, Baltimore, Md.

Serval Herbert, business engineer, engineering service corporation, Asheville, N. C.

George M. Keenan, efficiency engineer, Lehigh Valley Transit Co., Allentown, Pa.

T. Kennard Thomson, civil engineer, New York City.

W. H. Staver, mining engineer, New York City.

Robert Sibley, eminent mechanical and electrical engineer, editor in chief Journal of Electricity and Western Industry, San Francisco, Calif.

M. Duncan, of Duncan, Young & Co., consulting engineers, New York City.

Paul D. Sargent, chief engineer, State highway commission, Augusta, Me.
W. W. Stevenson, power plant efficiency engineer, Pittsburgh, Pa.
H. W. Turner, mining engineer, Mills Building, San Francisco, Calif.
M. M. Wills, mechanical engineer, Fitchburg, Mass.
Philander Betts, chief engineer, board of public utility commissioners of New Jersey, Newark, N. J.
R. N. Coffman, electrical engineer and designer, Newark, Ohio.
James Coyne, engineer, Boston, Mass.
E. E. F. Creighton, engineer, Schenectady, N. Y.
Charles J. Costigan, county Engineer, county of Summit, Okron, Ohio.
O. R. Delamater, of the Chadwick, Delamater Corporation, New York City.
H. Deverell, president Deverell, Spencer & Co., contracting engineers, Baltimore, Md.
A. F. Fischer, C. E., Johnson County engineer, Iowa City, Iowa.
A. J. Eddy, department of civil engineering, University of California, Berkeley.
C. Poole, chief engineer, Southern Sierras Power Co., Riverside, Calif.
Paul M. Downing, Pacific Gas & Electric Co., San Francisco, Calif.
Frank H. Drury, 10 South LaSalle Street, Chicago, Ill.
Angus S. Hibberd, consulting engineer, Bell Telephone Building, Chicago, Ill.
Gordon Strong, Chicago.
S. H. Woodbridge, engineer, Langford House, Cape Porpoise, Me.
C. A. Norman, professor of machine design, Ohio State University, Columbus, Ohio.
J. C. Stevens, consulting engineer, Spalding Building, Portland, Oreg.
W. A. Silliman, mining engineer, Altoona, Pa.
F. L. Bishop, dean School of Engineering, University of Pittsburgh, Pittsburgh, Pa.
J. C. Nagle, dean, department of engineering, Agricultural & Mechanical College of Texas, College Station, Tex.
Martin Penhallick, engineer and farmer, Neppel, Wash.
C. E. Grunsky, San Francisco, Calif.
And thousands of others.

SCIENTISTS AND INVENTORS.

It is well known that scientists and inventors are unanimous in favor of the metric system. Under the strange reasoning of obstructionists the fact that these experts who employ the metric units in their practical work are outspoken in their advocacy of the metric advance is used as an argument against the metric system. It is in truth the most eloquent testimony as to the convenience and utility of the metric units that those who have actually worked with them are enthusiastic urgers of their wider use throughout education, commerce, and industry. Industry in its modern sense is based almost entirely upon the discoveries and researches of these scientists and inventors, and industry now should heed their urgings that it gradually place itself upon the world metric basis to gain utmost efficiency.

In the chapter on "Organized effort" are listed hundreds of scientific associations which are active in advocacy of the metric advance. The leading part of the American Association for the Advancement of Science is pointed out; and likewise the progressive attitude of the National Institute of Inventors and similar organizations. Elsewhere in this volume are cited the favorable statements of such scientists and inventors as Alexander Graham Bell, Luther Burbank, Thomas A. Edison, John Hays Hammond, Hudson Maxim, A. E. Kennelly, H. V. Arny, and other eminent men. (Consult the Index.) It may be put down as a verity that all scientists favor the metric system; so that but a few statements need be instanced here to show their unanimity:

Alexander McAdie, director, Blue Hill Observatory, Readville, Mass. (Harvard University): "Blue Hill Observatory uses the metric system, and winds have been for 15 years recorded in meters per second and not miles per hour. * * * The United States of America can not differ as to the advisability of joining hands with 35 other nations of the world in the adoption of sensible and scientific units of measure." (Professor McAdie uses metric units exclusively in his book, Principles of Aerography. He was for 18 years in charge of the United States Weather Bureau, San Francisco.)

Herbert T. Wade, editor of Physics and Applied Science, editor of the New International Encyclopedia, and a world industrial authority of note, writes in the Scientific American: "In modern manufacturing, cost analysis and accounting has become as general as it is necessary, and this involves considerable clerical work and calculation. Even to-day the metric system could be introduced into much industrial work with small expense in the way of providing suitable weights, measures, scales and weighing machines; and in the control of processes the data at any stage would be secured and handled with much less effort and clerical labor. The experiment should be well worth the effort. Indeed to many engineers who have given thought to the matter the practical efficiency of the use of international metric weights and measures is a single argument sufficient to warrant its adoption."

E. P. Lewis, professor of physics, University of California (September 19, 1921): "I do not think that we can hold out against the practical advantages of the metric system and its stimulating influence on commercial relations. Some day the world will certainly adopt an international system, and it is safe to bet that it will not be the English. When the change comes it will be brought about by economic pressure, not by argument."

Francis Lowell Burnett, eminent pathologist, Boston, Mass.: "In my laboratory I have adopted the metric system entirely; and for long have felt the need for the universal system of weights and measures."

Garrett P. Serviss, eminent astronomer and writer: "The metric system of weights and measures is far preferable to the English." (In New York Evening Journal, July 15, 1921.)

Paul Drolshagen, scientist and author, Tampa, Fla.: "This last war was a lesson to us. I have seen our engineers in their frantic efforts to transcribe into metric units the old-fashioned weights and measures now in use, and, while I am not a statistician, I can safely assert that adoption of the metric system 10 years ago would have meant a saving of millions of dollars to our country during the war."

G. R. Brigham, Smithsonian Institution, Washington, D. C. (May 10, 1919): "I am very glad to give the meter-liter-gram system my indorsement unofficially, because our papers circulate so widely abroad. A standard system would obviate much extra work on our part."

R. R. Snowden, agricultural chemist, Los Angeles, Calif. (May 12, 1919): "I wish to indorse unconditionally the exclusive use of the metric system of weights, measures, and coinage as a world necessity, to say nothing of its supreme simplicity and usefulness as a local practice."

E. E. Schneider, wood expert, Bureau of Forestry, Manila, P. I. (December 26, 1919): "I have been a strong advocate of the adoption of the metric system for years."

F. E. Stewart, director of scientific department of H. K. Mulford Co., Philadelphia (December 9, 1919): "We are working under a handicap in this country in relation to our trade with those nations of the world where the metric system is in vogue; and it would certainly be a great advantage to all concerned if we could have a universal standard for weights and measures."

Thousands of other scientists have publicly urged exclusive adoption of the metric units by the United States of America. A number of these may be cited as typical:

William James Beal, noted botanist, Amherst, Mass.

C. E. Bogardus, of the Bogardus Testing Laboratories, with offices in many American cities.

R. S. Ellis, director, Water Purification Laboratories, Chicago, Ill.

Russell C. Erb, of the Russell C. Erb Laboratory, Bethlehem, Pa.

James Howard Gore, mathematician, scientist, astronomer, geographer, George Washington University, Washington, D. C.

W. M. Grosvenor, consulting chemist, New York City.

K. H. Knudson, official chemist for the Norwegian-American Chamber of Commerce.

John M. McCandless, of the McCandless Laboratories, recently State chemist of Georgia.

F. F. Millspaugh, curator department of botany, Field Museum of Natural History, Chicago, Ill.

E. W. Nelson, Chief Bureau of Biological Survey, United States Department of Agriculture.

R. L. Nougaret, viticulturist in charge State department of agriculture, Sacramento, Calif.

G. R. Wieland, eminent paleontologist, New Haven, Conn.
William Trelease, botanist, Urbana, Ill.
David Fairchild, eminent botanist of United States Department of Agriculture, Washington, D. C., and innumerable others.

PHYSICIANS, SURGEONS, AND PHARMACISTS.

In the chapter on "Organized effort" evidence has been given of the wholehearted support of metric standardization by physicians, surgeons, and pharmacists. Not only have their national and local associations worked to extend the use of the metric units, but individually they have expressed themselves decisively. Such men as Gen. Gorgas, Dr. Harvey W. Wiley, William J. Schleffelin, S. L. Hilton, Dr. Henry Smith Williams, E. L. Fisk, (medical director of the Life Extension Institute), and others eminent in these fields are quoted elsewhere in this volume. Opinion in favor of gradual metric standardization is virtually unanimous among physicians, surgeons, and pharmacists, but a number of typical statements will clearly indicate this unified position:

Dr. Charles H. Mayo, of the famous team of Mayo Brothers, physicians, Rochester, Minn. (who gave $2,000,000 for the good of humankind): "The metric system is now used generally by the medical profession and should be standardized for universal use."

Dr. Francis E. Fronczak, health commissioner, city of Buffalo, N. Y.: "I am strongly in favor of any measure that will bring about the universal use of metric units."

Dr. C. L. Olsen, member of State board of medical examiners, Salt Lake City, Utah: "Words can not express the manifest incongruity exhibited by the use of the present chaotic system (?) of measurement in the United States and Britain."

Dr. C. B. Pinkham, secretary-treasurer, board of medical examiners, State of California: "I heartily indorse legislation that will bring about the exclusive use of meter-liter-gram by the United States of America."

Dr. R. H. Needham, Arlington Heights Sanitarium, Fort Worth, Tex.: "I fully realize the usefulness and simplicity of the metric system. I wish that all other weights and measures were at the bottom of the sea."

Arthur G. Hulett, secretary, Arizona State Board of Pharmacy, Phoenix, Ariz. (April 22, 1919): "I have always indorsed the metric system and trust it will now be established."

Dr. Raley Husted Bell, New York City: "The stupid inertia that withholds the universal adoption of the metric system is almost incomprehensible."

Dr. A. J. Casselman, department of health, State of New Jersey (December 18, 1919): "This bureau wishes to cooperate in standardizing weights and measures. This office does not use any other form of measurement than the metric."

Dr. Omar T. Cruikshank, Pittsburgh, Pa.: "I have used the metric system for almost 30 years as far as possible in my work, and always wondered why it was not used exclusively for everything, especially when it is necessary to convert it into the various barbarous systems in use here."

Orel Jones, president Nebraska Pharmaceutical Association, Oconto, Nebr. (April 10, 1920): "We at the present time in this part of the United States of America still use the peck and bushel for the measuring of grain and farm products, but you do not have to go very far west from here until you see them using the hundredweight entirely. If it is so much more convenient for them to use the hundredweight when the other weights are official, why would it not be still more convenient to have all weights go by 10s, as our coinage does?"

Among the other physicians, surgeons, and pharmacists whose opinions in favor of meter-liter-gram might be quoted are—

Dr. Emile Altman, New York City.
Dr. K. Garnsey Brownell, 132 East Sixtieth Street, New York City.
Dr. William Buchanan, commissioner of health, Hammond, Ind.
Andres Catanjal, district health officer, Iloilo, Philippine Islands.
Dr. Andreas F. Christian, the Stoughton Sanitarium, Stoughton, Mass.
Walter E. Conley, acting general medical superintendent, Metropolitan Hospital, Blackwells Island, New York City.
Guy L. Edie, colonel, Medical Corps, San Francisco, Calif.
Dr. A. Frackelton, dentist, Milwaukee, Wis.
LeGrand Haskin, optometrist, St. Petersburg, Fla.

N. Hayes, surgeon, Nebraska Soldiers and Sailors' Hospital, Burkett, Nebr.
Dr. J. N. Hurty, secretary State board of health, Indianapolis, Ind.
Dr. William Keith, physician in charge, Tjisaroea Mission Hospital, Buitenzorg, Java.
Dr. J. E. Klotz, Westboro, Mass.
Dr. J. H. Kolter, dentist, Wausau, Wis.
H. H. Laughlin, superintendent of eugenics record office, Carnegie Institute of Washington.
Frank Brewer Merchant, eysight specialist, Brooklyn, N. Y.
Dr. Adolph Meyer, Johns Hopkins Hospital, Baltimore.
Edwin R. Morris, D. D. S., Paterson, N. J.
Dr. John W. Mowell, State medical board, Olympia, Wash.
Dr. H. N. Nelson, president Utah State Dental Society.
Dr. R. M. Pearce, general director division of medical education, Rockefeller Foundation.
Dr. George B. Peck, former honorary president of the American Institute of Homeopathy, Robinson Hospital, Berea, Ky.
Dr. R. W. Shufeldt, noted medical author and physician, Washington, D. C.
W. R. Tipton, M. D., superintendent of State Hospital, East Las Vegas, N. Mex.
Dr. A. B. Wadsworth, director department of health, State of New York.
Maj. Joseph H. Way, president State board of health, North Carolina.
Dr. R. W. Wilcox, noted medical author, New York City.
Weber Clinic, Davenport, Ohio.
Wood Vaccine Institute, Chicago, Ill.
And thousands more.

On file with the Department of Commerce, Washington, D. C., are 11,000 petitions from physicians and surgeons urging the passage of metric-standards legislation.

AGRICULTURE AND FORESTRY.

That metric standardization would bring great benefit to agriculture throughout the United States of America is acknowledged by all who have thoroughly investigated the present unstandardized, chaotic condition of weights and measures in our rural districts. Senator E. F. Ladd, of North Dakota, who for 30 years has labored to promote the best interests of the agricultural communities, as well as the best interests of all the people, is the leader of the metric forces in the United States Senate. He introduced the Ladd metric standards bill with the aim of facilitating the merchandising of American commodities, including agricultural products, throughout the world. Senator Ladd was the organizer of the great agricultural conference in Washington, D. C., January, 1922, and is a prominent member of the agricultural group of the United States Senate. This group of 22 Senators is committed by its program to support world metric standardization of weights and measures.

As one close student of world agricultural conditions has said: "It will greatly aid the American farmer when his products are quoted in billions of copies of newspapers, journals, and magazines through all the whole world in the world language of quantity—meter-liter-gram—so that all will understand; world pound, world ton, world quart, world yard. In the world measures of quantity, understood by the whole human family, the farmer can see and understand whether or not the farmer gets his just share under the quotations and prices being paid for farm products. The juggery pokery of antique measures of quantity should be forthwith scrapped. Let the farmer see!"

The large majority of agricultural experts and workers who have given consideration to this matter urge the metric standards. Thousands of statements could be cited, and from among these a number will be here given to present the overwhelming consensus of opinion favorable to the metric advance.

J. R. Howard, president American Farm Bureau Federation (February 2, 1922): "I would personally be very glad to see the metric system introduced in the United States and will give the measure encouragement."

Samuel Adams, editor American Fruit Grower, Chicago, Ill. (January 31, 1922): "It is my personal belief that the idea of bringing the world over to a new (metric) standard is advisable, and I will be very glad to cooperate to secure such a result."

E. T. Meredith, when Secretary of the United States Department of Agriculture, Washington, D. C. (June 16, 1920): "I have noted with interest the arguments in favor of the international metric system. In the scientific services of the Government as well as in the scientific institutions of this country,

the metric system has long been established. For this reason, and because it is felt that science and industry would be brought into even more intimate relations by the adoption of the metric system, the officials of the scientific bureaus of the department are of the opinion that advantages would result from the general adoption of the metric system as the standard of weights and measures of the country."

Henry C. Wallace, United States Secretary of Agriculture, Washington, D. C. (July 18, 1921): "The adoption of the metric system should result in preventing a vast amount of confusion and unnecessary labor that is inevitable with the system now used. However, the change from the present system to the metric system would very profoundly affect many industries, and for that reason no steps looking toward a change should be made without first giving very careful consideration to the methods of change which would bring the least amount of hardship upon those concerned."

Arthur Sampson, national secretary-treasurer American Society of Equity ("an organization that teaches cooperation among farmers"): "We are in favor of the metric system. The adoption of the metric system by the United States of America would greatly facilitate and reduce labor of computation. I believe it would be to the advantage of both instruction and practice."

J. C. Mohler, secretary Kansas State Board of Agriculture, Topeka, Kans. (May 3, 1920): "I am heartily in favor of the adoption by the United States of the metric system of weights and measures."

Frank Spurrier, farm advisor, Stockton, San Joaquin County, Calif.: "I feel very strongly on this matter of our backward systems of weights and measures and will do all I can in furthering the adoption of the metric system."

C. P. Dadant, editor, American Bee Journal, Hamilton, Ill.: "The metric system is learned in a few hours by the least competent child. The English weights and measures are rarely learned fully in a whole life of practice. It is high time for the world to drop those irregular and intricate methods which require several unnecessary operations to achieve what is readily done in one operation by the decimal metric system."

"Orchard and Farm," Los Angeles, Calif. (August, 1919): "There is really no excuse, in fact, other than that of established precedent, for continuing to use the antiquated system with which we are all familiar. And in this progressive age, precedent should furnish no serious obstacle to the adoption of improved standards. From Washington down, our best statesmen and economists have advocated the metric system; but it has been casting pearls before Congressmen only able or willing to think in terms of gallons of molasses, bushels of corn, and pounds of fat pork. They, and all of us, may as well accept the system, because the exigencies of trade shortly must force it upon the country."

F. A. Shipley Company, Santa Paula, Calif.; wholesale California walnuts and other products: "We are certainly with you on this metric advance, and will take steps to further the cause." (The California Almond Co. also urges the meter-liter-gram.)

"Dairy Farmer," Waterloo, Iowa (largest circulation of any dairy paper in the world), through Kirk Fox, associate editor (January 20, 1922): "We are in favor of the metric standards bill and hope to see it pass. While there are possible objections to the change of standard, we are convinced that they will be overcome as the old is gradually replaced by the new."

J. G. Lipman, director Agricultural Experiment Station, State of New Jersey, New Brunswick, N. J. (May 5, 1920): "I am heartily in accord with those who would establish meter-liter-gram as the standard of measurement."

H. A. Lyon, director Bureau of Markets, Department of Agriculture, State of Idaho; also State Sealer of Weights and Measures (February 3, 1921): "Personally, the writer is of the opinion that the metric system is much more efficient than our present standards."

Adn. Hernandez, director of agriculture, government of the Philippine Islands (July 8, 1920): "I heartily indorse the campaign for the standardizing of weights and measures on a decimal basis. The meter-liter-gram system is in use in the Philippines and is highly satisfactory."

"National Nurseryman," Hatboro, Pa. (September, 1919): "The average child of 10, who knows the metric decimal dollar and its subdivision, can learn in 10 minutes as much of the metric system as 90 per cent of all the people ever have occasion to use. The nurseryman has, to a great extent, adopted the metric system in his catalog, quoting price by the 10 and 100 instead of dozen and gross, and will realize to a certain extent the tremendous saving in effort

ıat could be applied in more profitable effort in other lines. It is a subject hat deserves the interest of every citizen, and when opportunity occurs, they hould urge the legislators to adopt the meter, liter, and gram."

Atlee Burpee, of W. Atlee Burpee & Co., one of the largest seed firms of he United States of America: "The metric system would insure the farmer ı fair measure. In our business we deal directly with the farmer and study ıis needs and wishes. I wish every farmer in the United States could have it ›rought home to him that the adoption of the metric system would save him ıot only endless confusion and vexation, but would also prevent his purchasing what he thinks is one thing, but which very often turns out to be something ntirely different. The widely different State laws as to what constitutes a egal bushel of seed make it possible for the unscrupulous dealer to take ad-vantage of the purchasers.

"As an example, take onion sets. We sell what we call a 'heaping bushel' of from 38 to 40 pounds, whereas the farmer ordering his onion sets from the West or South will receive as low as 23 pounds to the bushel for his money. There is such an utter confusion owing to the different legal standards in lifferent States for the same thing that the farmer in buying his seed from various places has hard work to form any idea of what he is going to get. We ıave tried to remedy the matter in our own catalog by quoting prices in pounds. If the metric system were introduced, however, the farmer could be sure of getting the same quantity wherever he ordered, for the standard would be the same throughout the United States (and the world). We sell 23 kinds of grass and grain seed and the weight varies from 7 to 32 pounds per bushel. You an see how confusing the matter is.

"We are earnest advocates of the metric system. The fact that a one-half ilo (500 grams) so nearly approximates a pound will make it an easy matter or the farmer to get a relative idea of the comparative weights of the old and ew systems.

"We have found the farmer of to-day to ready adopt any new method that will elp him in his work and we feel sure that once he sees the advantage of the etric spstem he will throw his influence toward the adoption of 'one weight, ıe system' throughout the United States."

H. A. Bereman, editor Farmer and Breeder, Sioux City, Iowa: "I have een preaching standardization of weights and measures for 20 years, and have ritten editorials against our clumsy bushels, tons, and quarts, where weights ıould be used. Now, I am ready to indorse the final standardization of weights ıd measures in this country by the universal adoption of the metric system."

J. A. Schmidt, secretary of the Richardton Milling Co., Richardton, N. Dak. October 23, 1919): "We favor the change to the metric system very much. ad occasion to talk this over with quite a few farmers in this territory, who ise such grains as wheat, rye, barley, corn (maize), flax, oats, and vegetables all kinds, and they all felt that it would be a better way of trading than e present system. As one expressed himself, it is easier to figure and helps ose that are not rapid at figures to figure over their sales and see if they have ceived the correct amounts due them.

"We consider the cost nothing in comparison with the benefits received by is change for even domestic or local business such as we have here. We ndle all the above grains mentioned, buying them and selling them, and the ices change almost daily, so we have a long system of figuring receipts and les every day into bushels and odd pounds in order to know just where we e at, so as to keep the goods properly 'hedged' in the markets, or sold ahead, us avoiding any loss in form of speculation. If the items would all show in world) pounds, by pointing off two figures, we would have it in hundred-eights—which would evidently be the sale measure in large lots, and by only ıncing at the books we could tell where we are at. We heartily recommend e adoption of the metric-liter-gram."

William B. Greeley, Chief of the United States Forestry Bureau and head of e United States Forestry Service in France during the World War: "American nber jacks and foresters who served in France during the World War were rced to use the world metric system in measuring timber, logs, piling, and nber. They found the metric system, which was used in all the French timber erations, exceedingly simple and easy to handle."

Emanuel Fritz, division of forestry, college of agriculture, University of lifornia (February 7, 1921): "I shall do what I can to advance the adoption

of the metric standards. I was particularly impressed with the metric system during my stay with the American Expeditionary Forces in France."

Successful Farming, through Alson Secor, editor (February 11, 1922): "We are not agreed among the States as to the standard bushel. Custom uses the long ton and short ton for various things; the land mile and the nautical mile; the hamper for one class of products and the basket for another. Cases, crates, baskets, and packages are as numerous as different lines of marketing care to adopt. Perhaps the metric system would not do away with all these, yet when we reform our standards we may as well endeavor to eliminate sectional product and personal standards of measure. It would seem as if it would be impossible for adults to learn a new metric system, but when we remember that the boys of the American Expeditionary Forces soon talked in terms of kilometers instead of miles, we take courage and advocate the change. If done gradually we will make the change without much effort.

"A standard, universal system of measures would be more desirable, even, than a universal language. It would be more difficult for the children in the schools to learn two systems for a period of time, but in the near future education would be relieved of the multiple systems we now use. It would be confusing to all who used old statistics. They would have to interpret all past figures into the new standard, but some one would probably make a business of that for us. Bankers must study the fluctuating values of money when they deal with foreign countries. They soon get so they can think in terms of foreign exchange. So do exporters become familiar with not only foreign exchange but foreign measures. It is not an impossible task, therefore, to learn another system which ultimately will become the one system for the world. No foreign system can be more confusing than our own conglomerate method of measuring." (Successful Farming, published at Des Moines, Iowa, by E. T. Meredith, former United States Secretary of Agriculture, has a circulation of over 800,000.)

Joint Commission of Agricultural Inquiry, in report to Congress of the United States of America, 1922: Standards of agricultural products and containers: "One of the elements which is now lacking in considerable measure, at least in the procurement of agricultural statistics, is a basis of standardization of agricultural products and containers. Standardization of agricultural products and containers is likewise essential to any adequate scheme of marketing and distributing farm products if unnecessary waste and losses in the process of marketing and distribution are to be avoided. The process of distribution will be greatly facilitated by sound and practical standards and grades applied to agricultural products in commerce. Standardization will likewise increase the opportunity of the consumer to secure the exact thing for which he bargains and to measure the quality of the product which he buys."

"The County Agent and Farm Bureau," through W. F. Atkinson, business manager, Chicago, Ill.: "We are for the metric system first, last, and all the time." (This organization also conducts the National Crop Improvement Press Service.)

G. W. Norris, chairman of the Committee on Agriculture and Forestry, United States Senate: "Our present system of weights and measures is so out of date that we ought to take some steps to remedy and better it, and it seems to me the metric system does this. No defense whatever can be offered for our present system. When we broke away from England we very wisely discarded the shilling, pence, and pound of the English money system, but we still clung to the old system of weights and measures."

The opinion of experts in agriculture in favor of the world metric standards is typified by the advocacy of meter-liter-gram by Senator Arthur Capper, of Kansas, who, besides being prominent in the agricultural group in the United States Congress, is the largest owner of agricultural journals in the world. Hon. W. S. Kenyon, of Iowa, leader in agrarian legislation, also urges the metric advance. The opinion of Luther Burbank, world's greatest grower, is cited earlier in this chapter. He is a member of the advisory committee, World Metric Standardization Council.

It should be noted that many agricultural associations throughout the United States are cooperating in securing the metric standards for merchandising farm products. Among those cited earlier in this chapter are the American Society of Equity, Association of Official Agricultural Chemists, American National Food and Dairy Associations, Association of American Agricultural Colleges and Experiment Stations, National Conference of Food, Dairy, and Drug Officials, [illegible] others.

The steadily-increasing interest among practical farmers in the world metric standards is typified by several thousand petitions sent by farmers from all parts of the United States, urging passage of the British-Ladd metric standards bill. They realize that it facilitates the marketing of their products in the United States of America and throughout the world.

ARMY AND NAVY.

The vast majority of Army and Navy officers urge exclusive use of the metric units. In the World War, 4,000,000 American warriors employed metric units in actual practice, and became convinced of their superiority. Quoted elsewhere in this volume are such men as Gen. John J. Pershing, Gen. Leonard Wood, Admiral W. S. Sims, Admiral W. S. Benson, Admiral J. L. Jayne, Gen. Hunter Liggett, Gen. W. C. Gorgas, Col. Theodore Roosevelt, Col. Thomas H. Rees, Maj. F. H. La Guardia, Newton D. Baker, Franklin D. Roosevelt, Benedict Crowell (Director of Munitions in the World War), and many others in the military forces of the United States of America. Hon. Julius Kahn, head of the Military Affairs Committee of the House of Representatives, is an advocate of prompt metric legislation. In the chapter on metric standards legislation before Congress, an abstract is given of some of the testimony by Army and Navy officers favorable to gradual metric standardization.

Maj. Gen. J. T. Dickman, commanding Southern Department, Fort Sam Houston, Tex. (August 11, 1919): "I am highly in accord with efforts toward the universal adoption of the metric system and have forwarded petition to the congressional committee."

Maj. Gen. Wendell C. Neville, commander of the Fourth Brigade, Marines, Second Division, Amercan Expedtonary Forces, during the World War: "I favor the exclusive adoption of the metric system in the United States. It is much simpler and easier to work with than any other system yet invented, and it would facilitate commercial relations with many other nations that have already made it their single system of weights and measures."

Capt. Charles M. Whitlock, commanding officer Edgewood Arsenal, Midland Plant, Mich. (February 20, 1920): "I am heartily in favor of the official and practical adoption of 'meter-liter-gram' and the metric system, as well as of the world-wide standardization of all such trade facilities as the language and units that are basic on the dealings among diverse peoples."

Edward A. Spitzka ,former lieutenant colonel, Medical Corps, United States Army, New York City (April 26, 1919): "I approve of all movements toward universal adoption of metric system."

W. S. Thayer, brigadier general, Medical Corps, chief consultant, Medical Service, American Expeditionary Forces, 1918–19, Baltimore, Md.: "I am in favor of anything from prayer to military force to secure the establishment of uniform units of measure. I am mortified that a supposedly intelligent people should be so absurdly conservative."

A. W. Grant, commandant and superintendent, United States Naval Gun Factory, United States Navy Yard, Washington, D. C.: "The meter-liter-gram is practical, as is amply demonstrated."

John H. Soper, brigadier general, N. G. H. (retired), Honolulu, Hawaii (June 24, 1919): "I am greatly pleased to have the opportunity of expressing my hearty approval of the adoption of the metric system by the two great English-speaking nations. No argument was needed in my case as I have been in favor of this idea for more than 40 years past."

L. L. Hoare, lieutenant colonel, British Army: "You may be amused at the following story of a conversation of mine with two officers of the United States Ordnance Department, with whom I made near friends. I said: 'There is one thing about the United States which, when I realized it, filled me with horror and contempt.' This made them sit up and wonder what I was getting at; however, they quite politely asked me what it was, without knocking me down. I replied: 'You use the same ghastly weights and measures as we do.'"

Maj. John F. Landis, United States Military Attaché, Caracas, Venezuela (November 25, 1919): "South Americans do not like, understand, or care to learn the American and English system of weights and measures and only use them when forced down their throats. The metric system is more systematic, easier to learn, and easier to apply than the present. Our foreign commercial competitors use the metric system and have a great advantage over us in South America. It stands to reason that an adoption of the metric system could be

effected gradually and without any great inconvenience or monetary loss to our industries, and undoubtedly an adoption of this system would eventually lead to a monetary advantage on our part in South America alone far offsetting any possible loss to American industries as feared by some objectors to the same in the United States."

Leonard Lundgren, captain of Engineers, Army School of the Line, American Expeditionary Forces, France (October 22, 1918): "I believe that if this war lasts long enough the elementary use that our soldiers are making of the metric system in France will result in its universal use in the United States."

Henry A. Reed, brigadier general, United States Army (retired): "Money measurement is so universal that common sense forced us to break away from our cumbersome English standards, to our everlasting comfort and convenience. Now let us give common sense, convenience and comfort, reduction of time and labor, and the decimal point a chance, and get rid of the difficult conversion of different units and of quantities by discarding the rest of the English standards and adopting the metric, or decimal, system."

W. D. French, major, Air Service, Air Service headquarters, Morrison, Va.: "The International Millionth Map is to be upon the metric scale."

Frank G. Bolles, lieutenant colonel, Ordnance, member War Department Claims Board, Washington, D. C. (June 10, 1919): "A study of the subject will clearly show that, beyond a small percentage of those engaged in manufacture whose products are for local consumption, and who fail to grasp the tremendous advantages to be derived from the use of the metric system as a means of simplifying the work of production and distribution of our own products, there is no valid argument against its immediate use to the exclusion of the complex system we persist in continuing. United States money is already metric. Our factories and workmen during the last five years, due to production of war materials, have become familiar with the metric system. While Germany originated our complex system (see vol. 9, Transactions, Royal British Historical Society), Germany forever dispensed with its use in 1871 for the metric system."

Others in the armed forces of the United States of America typical of those urging gradual metric standardization of weights and measures are:

P. C. Harris, Adjutant General United States Army, Washington, D. C.

Maj. Gen. Peter E. Traub, Camp Pike, Ark.

Samuel McGowan, Paymaster General of the Navy.

Rear Admiral T. W. Kinkaid, Annapolis, Md.

R. H. Jackson, rear admiral, Naval War College, Newport, R. I.

Maj. Fiorello H. La Guardia.

E. B. Babbitt, brigadier general, United States Army, Camp Dodge, Iowa.

Mordecai Crawford, brigadier general, United States Army, Washington, D. C.

Gen. William Crozier, Chief of Ordnance.

Louis V. Caziare, brigadier general, United States Army, retired.

Maj. Emer Yeager, United States Field Artillery, Camp Benning, Ga.

Lieut. Newton Bishop Drury, United States Reserves, during the war officer in charge of flights, United States Balloon School, Arcadia, Calif.

Capt. Harold P. Nachtrieb, United States Marine Corps, in 1918 aid to Major General Barnett, commandant.

Maj. Edgar H. Brown, Marine Corps.

Maj. E. L. Wemple, Marine Corps.

Maj. H. A. Kluegel, Construction Division, United States Army, and thousands of others.

BANKERS AND BANKING INSTITUTIONS.

J. T. Holdsworth, economist and vice president, bank of Pittsburgh, N. A., Pittsburgh, Pa.: "There are no vaild arguments against the metric system."

Farmers' State Bank, Montague, Mich. (October 26, 1919):

"*Resolved*, That we respectfully urge that the units of the metric system be adopted by the Congress of the United States of America and the British Parliament as the exclusive legal standards of weights and measures."

J. W. Gregory, president, Cottage Grove Bank, Des Moines, Iowa: "The undersigned begs to join with those who are urging the provision of legislation which will most quickly bring about the exclusive use of the decimal system, commonly referred to as the metric system, as applied to weights and measures, by the United States of America. Our national experience with our decimal coinage system should have made us leaders instead of disgraceful laggards

in the movement to make these decimal systems of weights and measures world-wide, time-savings, and unifying agencies."

Theodore Wold, vice president, Northwestern National Bank, Minneapolis, Minn. (January 17, 1921): "If I can be of any assistance to the metric advance, I shall be very happy to render it."

Andrew J. Fraun, president, Waukesha National Bank, Waukesha, Wis.: "There appears no sound reason for not making a wonderful saving of time—and time is money—by adopting the metric as against all other systems of weights, measures, and money. As less-advanced nations have adopted it, it is inconceivable why Britain and the United States still cling to such antiquated methods. Therefore, may we ask, why not keep step with the best progress of the world?"

W. R. Williams, of the Bank of Italy, San Francisco, Calif.: "I have for some time been a strong advocate of the metric system, and I certainly hope for success in the very near future."

George L. Ramsey, president, the Banking Corporation of Montana, Helena, Mont.: "I have always been in favor of the metric system and will become a talking advocate in its favor."

Such eminent bankers as Otto H. Kann, James Speyer, and John J. Arnold are quoted elsewhere in this volume. The following list, which could be greatly extended, will indicate the unanimity of bankers (who have, of course, constant contact with the convenient decimal system of money) in favor of the decimal system of weights and measures:

I. N. Ballard, president, Bank of Greenville, Greenville, W. Va.
C. W. Banta, Wells Fargo Nevada National Bank, San Francisco.
H. A. Bent, president, Oglesby State Bank, Oglesby, Ill.
Frank W. Blair, president, Union Trust Co., Detroit, Mich.
John Bowen, president, First National Bank, Windsor, Mo.
Joseph M. Boyd, president, Bank of Wisconsin, Madison, Wis.
Henry Clark Bridgers, president, First National Bank, Tarboro, N. C.
E. O. Brown, president, Merchants' State Bank, Rhinelander, Wis.
W. J. Clarke, president, Emmet County State Bank of Michigan, Harbor Springs, Mich.
John Clausen, vice president and director, Mexico City Banking Corporation.
R. P. Cooke, president, the Hernando Bank, Hernando, Miss.
Walter H. Creber, president, the Rogers Park National Bank, Chicago, Ill.
G. A. Dayton, president, State Trust & Savings Bank, West Chicago, Ill.
C. P. Deming, president, the Peoples' Bank of Evergreen, Ala.
Guy E. Dobson, president, First National Bank of Redmond, Redmond, Oreg.
R. J. Donahue, president, the National Bank of Ogdensburg, Ogdensburg, N. Y.; First National Bank of Boulder, Boulder, Colo.; First National Bank of Clarkston, Wash.
J. A. Foster, president, the Union State Bank, Calvert, Tex.
R. N. Fredericks, president, the Prescott State Bank, Prescott, Ariz.
W. H. Frey, president, the Farmers National Bank, Stephensville, Tex.
J. A. Gelbach, president, First National Bank, Ellwood City, Pa.
C. H. Gilliland, president, Peoples Trust & Savings Bank, Goodwater, Ala.
W. H. Gold, president, State Bank of Redwood Falls, Redwood Falls, Minn.
Orville B. Gorin, president, the Millikin National Bank, Decatur, Ill.
C. E. Greene, president, the First National Bank, Richmond, Mich.
B. W. Griffith, president, the First National Bank of Vicksburg, Vicksburg, Miss.
B. Hadley, president, the First National Bank, Cambridge, Ill.
A. H. Hale, president, the First National Bank, Manchester, N. H.
J. F. Hardin, president, Citizens' Savings Bank, Eldora, Iowa.
Chas. K. Hart, president, Prosser State Bank, Prosser, Nebr.
A. Barton Hepburn, chairman of the advisory board, the Chase National Bank, New York City.
V. L. Highland, president, the Empire National Bank, Clarksburg, W. Va.
C. J. Hogeboom, president, First State Bank, Warner, S. Dak.
A. W. Hurley, president, Citizens' National Bank, Pawhuska, Okla.
N. Iverson, president, Mohall Security Bank, Mohall, N. Dak.
Henry E. Jewett, president, Second National Bank, New Albany, Ind.
Chas. Johnsen, president, Citizens' State Bank of Lake View, Chicago, Ill.
C. P. Jordan, president, First Savings Bank, Sutherland, Iowa.
H. R. Kibbee, president, Commercial Trust and Savings Bank, Mitchell, S. Dak.

L. V. Koontz, president, the First National Bank, Clendenin, W. Va.
J. Luchsinger, president, the Citizens' Bank, Monroe, Wis.
Frank S. Lusk, president, the First National Bank, Missoula, Mont.
J. A. Magoun, president, Northwestern National Bank, Sioux City, Iowa.
M. A. McCutchen, president, American National Bank, Shreveport, La.
J. C. McGinnis, president, First National Bank, Frackville, Pa.
Wm. L. Moore, president of Washington County Bank, Banks, Oreg.
N. P. Moss, president, the First National Bank of Lafayette, Lafayette, La.
A. W. Murphy, president, the Shenandoah National Bank, Shenandoah, Iowa.
R. L. Myers, president, Lemoyne Trust Company, Lemoyne, Pa.
Sigmund Ojserkis, president, the Boardwalk National Bank, Atlantic City, N. J.
The Peoples National Bank, S. R. Stevens, president, Marlborough, Mass.
G. A. Pestal, president, the Merchants' State Bank, Winside, Nebr.
Frank J. Pouska, cashier, Home Savings Bank, Fort Atkinson, Iowa.
G. B. Quarles, president, the Citizens' National Bank, Salmon, Idaho.
J. M. Raynolds, president, the First National Bank, Albuquerque, N. Mex.
A. C. Robinson, president, Peoples' Savings and Trust Co., Pittsburgh, Pa.
W. C. Soles, president, the National Bank of McKeesport, Pa.
A. D. Stephens, president, the Merchants' National Bank, Crookston, Minn.
A. L. Stone, president, State Bank of Dillon, Dillon, Mont.
M. E. Uggen, president, Citizens' State Bank of Epping, Epping, N. Dak.
C. D. Waggoner, president, the Bank of Telluride, Telluride, Colo.
Benjamin L. Webb, president, Cortland Savings Bank, Cortland, N. Y.
E. P. Willey, president, First National Bank, Chelsea, Iowa.
E. W. Wilson, governor, Philippine National Bank, Manila, P. I. (in 1919-20, vice president, World Trade Club).
A. A. Wilson, asst. mgr., the Canadian Bank of Commerce, San Francisco, Calif.
G. A. Wilson, president of Wilson Banking Company, Greenwood, Miss.
Sinclair A. Wilson, president, the First National Bank, Linnton, Oreg.
L. C. Woodfill, president, Farmers and Merchants Savings Bank, Gravity, Iowa.
C. H. Worden, president, the First and Hamilton National Bank, Fort Wayne, Ind.
Albert Zimmermann, president, First State Bank of Arlington, Arlington, Minn.
R. Calvert Haws, editor, "Successful Banking," Benton Harbor, Mich.
Albert G. Hammel, commissioner of finance, Saginaw, Mich.
G. H. Richards, secretary, Minnesota Bankers' Association, Minneapolis, Minn.

INSURANCE.

C. H. Jackson, superintendent of agencies, Security Mutual Life Insurance Co., Binghamton, N. Y.: "We are very glad to cooperate in any way we can with so wise a measure. Our feet can not be set on the right path in many of these world-wide matters any too soon."

T. F. Millett, secretary, Dirigo Mutual Fire Insurance Co., Gorham, Me.: "Anything I can do in the direction of the metric advance, as I believe it a very important thing, I will gladly do."

S. A. Olsness, commissioner of insurance, State of North Dakota: "It was indeed gratifying to me, having been brought up under the metric system in Europe, to learn that a vigorous campaign is launched to introduce it in this country."

D. J. Cooper, Equitable Life Assurance Society of the United States, New York City, N. Y.: "We would like to help in bringing about the world-wide use of the metric system."

C. E. Hydes, marine insurance department, Fireman's Fund Insurance Co., San Francisco: "For manifest reasons, marine insurance experts favor world standardization of weights and measures and the scrapping of confusing local standards which hinder the transaction of world business."

Walter C. Faxon, vice president, Aetna Life Insurance Co., Hartford, Conn. (August 8, 1919): "It affords me great pleasure to add my indorsement to the many others for the enactment of such legislation as may be necessary to accomplish the adoption in the United States of America of the metric system exclusively for all weights, measures, and for coinage."

C. E. Affeld, jr., Affeld, Tonk & Co., insurance agents, Chicago (May 15, 1919): "At a committee meeting of the Chicago City Club I was handed the convincing circular of the World Trade Club on the metric system of weights and measures while introducing a proposition to compel all packages of liquids or solids now marked by our weights and measures to be marked with its equivalent in the metric system, thus familiarizing the public with the system and the eventual adoption."

From the long list of insurance organizations urging the metric advance, we may cite the American Bankers Insurance Co., Chicago, Ill.; Armstrong Agency, insurance, New York City; Home Insurance Co., New York City; Ohio State Life Insurance Co., Columbus, Ohio; Pacific Mutual Life Insurance Co., Los Angeles, Calif.; Prudential Insurance Co., Newark, N. J.; and many others. The eminence of Hon. Joseph S. Frelinghuysen, in the world of insurance, is well known. It was he who presented the metric standards bill of 1920, and this progressive measure was indorsed by insurance men throughout the United States of America.

LAWYERS AND JURISTS.

Among the eminent lawyers and jurists quoted elsewhere in this book are Elihu Root, William G. McAdoo, John Barton Payne, Frank L. Polk, Franklin K. Lane, Franklin D. Roosevelt, and many others.

Edgar V. Werner, judge of the circuit court, Shawano, Wis.: "I am very much interested in the propaganda for the betterment and the equality of commercial dealings. The laudable ambition of the World Trade Club should be considered by every good American citizen."

W. L. Seabrook, State's attorney, Westminster, Md.: "The argument of the World Trade Club appears to me unanswerable."

C. de Smedt, L. L. D., attorney at law, vice consul of France, Galveston, Tex.: "The demand for the metric system should be sustained by every sensible man. The metric movement is sure to succeed."

H. W. Glensor, commerce attorney, president, Foreign Trade Club of San Francisco (World Trade Club): "Simple and rational terminology in weights and measures is necessary to free us from our present confusion, which is worse than most people realize. The metric units are not only the simplest and most convenient, but above all they are the world units on which all nations are standardizing. Practical use of the meter, liter, and gram, while in the Army, first in the Philippines and later in France during the World War, convinced me of their superiority and utility."

James Watson, county judge of Coos County, Coquille, Oreg.: "I have often wondered why the metric system wasn't universally adopted by the world, being so very convenient and efficient."

A. C. Stein, attorney at law, Pittsburgh, Pa.: "All my life I have been wondering what power could keep in force our crazy method of weights and measures."

Clarence M. Oddie, attorney and counselor at law, San Francisco, Calif.: "I am very heartily in favor if this cause."

H. Walter Huskey, attorney and counselor, Reno, Nev.: "For 10 years I taught the metric system in the public schools. I am very glad to join in any effort within my power to secure this reform at this time of world adjustment of such matters."

W. B. Dillard, attorney, St. Helens, Oreg.: "I have known erroneous land descriptions ending in lawsuits, building material miscut and wasted, buildings wrongly located, bridges rendered dangerous, and storage room sadly miscalculated owing to confusion in units of measure. In fact, the terms chains, rods, poles, links, yards, feet, and inches are often used in the same description taken from adjacent surveys, and are confusing even to an experienced person. What is applicable to linear measure is equally applicable to bulk and weight. No wonder that about half our people are sadly incapable of forming estimates on subjects with which they should be familiar as with dollars, dimes, and cents. I should say that a mixed and confused manner of calculating distance, bulk, and weight has always been an impediment to clear understanding among English-speaking people. Language is but the clothing of thought, but by clarifying the expression of thought we clarify thought itself."

E. S. Cobb, attorney, El Paso, Tex., February 24, 1920: "During the time that I was collector of customs at El Paso I was so strongly impressed by the need for the United States adopting this system that I submitted a carefully prepared report on the subject to the Secretary of the Treasury."

Theodore Sutro, eminent lawyer, senior member of law firm of Sutro & Wright, New York City (March 8, 1920): "I have for many years advocated a uniform system of weights and measures among all the nations, as far as possible, and I am now even more in favor of this than at any time. The metric system would be the solution of this idea. It is not only that such a uniform system of weights and measures would be of great convenience in correspondence and otherwise, but would make, the same as any universal habit or custom among the countries of the world, for bringing them closer together, and tend to prevent disputes and misunderstandings, and thus, in consequence, avert serious conflicts and war."

Ralph M. Snyder, associated with the law offices of Rummler & Rummler, Chicago, by experience is competent to judge whether or not the international metric system is simpler and more effective than our present system of weights and measures. He writes (May 21, 1919): "My experience as adjutant of the aviation repair depot at Indianapolis, where we were concerned largely with local and foreign measurements in the building of airplanes and parts, convinces me of the urgent necessity of the adoption of the meter-liter-gram in this country. This conclusion is also compelled by reason of the difficulties of the present system in patent soliciting and patent litigation, and the experiences of our clients who are confronted with the difficulties of the old system."

Stansbury Hagar, counsellor at law, New York City: "I am in hearty sympathy with the purpose of securing the early world-wide use of meter-liter-gram."

Andrew J. Branagan, attorney and counsellor at law, San Francisco, Calif.: "Standardization would justify the adoption of the metric system, but when you add to that the high degree of merit which it possesses of itself, the arguments for its adoption become unanswerable."

Matthew Brady, district attorney, city and county of San Francisco, Calif.: "I sincerely hope that this important advance in efficiency will meet with a ready response from all national organizations."

Among the other lawyers and jurists who have indorsed the metric progress may be mentioned:

W. H. Crichton Clarke, general counsel, Kellogg Toasted Corn Flake Co., New York City.

Frank C. Drew, Balboa Building, San Francisco, Calif.

Francis B. James, noted interstate commerce attorney, Washington, D. C.

S. W. King, Federal judge, Chicago, Ill.

D. H. Ingraham, former mayor, Portland, Me.

Henry Orth, patent attorney, Washington, D. C.

Rice & Lyons, Tulsa, Okla.

William G. Marvin, of Marvin & Pleasants, 120 Broadway, New York City.

O'Donnell & Graham, Denver, Colo.

Frank J. Loesch, president of Chicago Bar Association, 1906–7, counsellor at law, Chicago, Ill.

H. H. Phleger, San Francisco, Calif.

L. E. St. John, judge, Miami County, Ohio.

Stanton J. Peellee, chief justice, United States Court of Claims, 1906–1913, Washington, D. C.

Lindley D. Clark, legal expert, U. S. Bureau of Labor Statistics.

Robert T. Ervin, judge, United States District Court, Southern District of Alabama, Mobile, Ala.

A. Bruce Hopkins, Buffalo, N. Y.

Clyde M. Gandy, assistant attorney general, State of Arizona, Phoenix.

F. E. Pailard, assistant attorney general, State of North Dakota.

Willard W. Miles, justice of the Supreme Court of Vermont, Barton, Vt.

CLERGY AND RELIGIOUS CONGREGATIONS.

Church of Christ, Macy, Ind.: "The congregation voted unanimously to indorse legislation that will bring about the exclusive use of the meter-liter-gram by the United States of America."

Rev. J. Rivera, Canovanas, Porto Rico: "I am a warm advocate of the metric system and its promotion."

Rabbi Emanuel Sternheim, Sioux City, Iowa: "I am in deepest sympathy."

William F. Weir, general national secretary and treasurer, men's work, Presbyterian Church: "I favor the gradual adoption of the decimal metric standards of weights and measures in the United States, during a transition period of 10 years."

Rev. Joseph R. Crimont, bishop of Alaska, Juneau, Alaska: "Yours is a movement in the right direction."

Rev. Martin Branagan, Perry Green, Mich.: "I have striven on all occasions to heap ridicule on the existing system and to urge the adoption of the decimal metric units."

Rev. B. H. Taylor, pastor of the Ganson Street Baptist Church, Jackson, Mich.: "I wish to say that my church stands for the adoption of the meter-liter-gram system in the United States and its exclusive use therein."

Rehobeth Baptist Church, Rehobeth, Md. (September 18, 1919), voted resolutions unanimously urging Congress to adopt meter-liter-gram as the exclusive legal standards of weights and measures in the United States of America.

Rev. C. M. Worthington, missionary, Methodist Mission, Singkawang, West Borneo (January 10, 1920): "As an American missionary of the Methodist Episcopal Church having had nearly 20 years' experience in teaching the English language to Chinese, Malay, and Tamil children, and having to deal with Chinese, Malay, and European merchants and officials, I heartily indorse any measure that may be taken to introduce and enforce the use of the meter-liter-gram system not only by the United States of America, but by all nations of the world."

A. R. Thompson, Presbyterian missionary, Mayaguey, P. R. (September 20, 1919): "From my 10 years' experience here with the metric system, I realize the very great advantage this has over our antiquated and expensive systems, and certainly now is the time to effect this advance."

G. C. Brinkman, clergyman, Elkins, N. C. (February 27, 1920): "I am heartily in favor of the metric system, having been in business before I became a minister."

Southern Baptist Theological Seminary Library, Louisville, Ky.: "We are in fullest sympathy with the effort to have the United States adopt metric-liter-gram."

Dr. Frank G. Lewis, librarian, American Baptist Historical Society, Chester, Pa. (March 1, 1920): "It is a pleasure to share with the large majority, I think, of thoughtful and practical Americans the wish that the metric system may soon become for the United States not only allowed but exclusively used in our affairs."

George Rutger Brauer, treasurer board of the church erection fund of the General Assembly of the Presbyterian Church in the United States of America, New York City: "It seems to me that it would be of a great advantage for both the United States of America and the British Empire to adopt this system and thus have uniform systems of weights and measures for all the nations of the world."

Francis B. Nash, acting rector, Trinity Episcopal Church, Chicago, Ill. (September 3, 1919): "For 40 years I have advocated this common-sense union with all the rest of the civilized world in the immensely important matter of weights and measures. As a student of history all my life I have seen the foolishness of our standing aloof with our awkward, misbegotten, and absurd system of weights and measures, and as a man who has been much concerned and active in agricultural production I have long seen the deplorable error from every standpoint, save the immediate convenience of shrinking the inevitable in changing systems, of our obstinate refusal to make the world of business, manufacture, production, and transportation unanimous in this profoundly important concern."

Paul de Schweinitz, D. D., Bethlehem, Pa.: "I am most heartily in favor of the metric system, and have been for years."

H. B. King, Evangelical School Press, Samokov, Bulgaria: "Let the necessary legislation be hastened. Standardized weights and measures can not come too soon for me. No reasonable man can oppose such obviously beneficial changes as this to the metric system."

L. W. Rogers, national president, Theosophical Society, American section, Los Angeles, Calif.: "Speaking merely for myself, I favor the gradual adoption of the decimal metric standards in commercial transactions."

Henry Smith Leiper, American Board Mission, Tientsin, China: "Living in an international center such as Tientsin, I appreciate the need for a world standard—the metric system."

Among the thousands of clergymen, missionaries, and religious congregations which have urged the metric advance are:

Walter Bishop Bell, minister, First Presbyterian Church, Port Townsend, Wash.

William Edward Cox, rector, Church of the Holy Comforter, Richmond, Va.

Ozora S. Davis, president, Chicago Theological Seminary, Chicago, Ill.

Charles C. Jacobs, Centenary Methodist Episcopal Church, Charleston, S. C.

C. A. Jessup, rector, St. Paul's Church, Buffalo, N .Y.

J. M. Koudelka, bishop of Superior, Wis.

I. W. Lowrie, chairman, the China Council, American Presbyterian Mission (North), 18 Peking Road, Shanghai, China; Saint Philip Benize's Church, Chicago, Ill.

Clinton Senneff, First Methodist Episcopal Church, Crawford, Nebr.

R. Shemeld, Bethany Chapel of New York Avenue Presbyterian Church, Washington, D. C.

Frederick J. Stanley, D. D., L. H. D., Newburgh-on-Hudson, N. Y.

H. F. Swartz, general secretary, Congregational World Movement, New York City.

E. H. Wilcox, director, Adventists Mission, Lima, Peru.

W. C. Paige, general secretary, Young Men's Christian Association, Houston, Tex.

R. G. Galyards, secretary, Reorganized Church of Jesus Christ of Latter Day Saints, Independence, Mo.

W. I. Haven, general secretary, American Bible Society. Astor Place, New York City; and many others.

EDUCATORS.

The fact that educators are virtually unanimous in favor of the decimal metric system is well known. Opponents use this as an argument against the metric system, and it is of the same quality as all of their contentions. Surely, those who have occasion to investigate and study both the metric system and the cumbersome jumble we now have, should be in the very best position to advise the Nation as to which is superior. They are the experts on this subject, and their overwhelming verdict for the logical decimal units should be conclusive.

Already in this volume we have seen that such educational leaders as Charles W. Eliot, Nicholas Murray Butler, George E. Vincent, and Arthur T. Hadley are strongly in favor of prompt adoption of the metric system. The opinion of the International Correspondence Schools, and similar institutions, has also been cited. Before instancing typical support from educators, it will be well to quote the resolution passed unanimously by the National Congress of Mothers a Parent-Teacher Association, in Washington, D. C., April, 1921:

"Whereas it is generally agreed that the present system of weights and measures used in the United States is cumbersome and a hindrance to the American school children; and

"Whereas American educators are practically unanimous in favoring the replacement of the present system with the international metric system of weights and measures; and

"Whereas statistics show that practically one year in the school life of every American child could be saved if the decimal metric system of weights and measures were taught instead of the present system; and

"Whereas the enormity of loss in time and money can be somewhat appreciated when it is remembered that, according to the statistics of the United States Bureau of Education, there are about 22,000,000 public-school children in our country being educated at a cost of not less than $800,000,000 per year; and

"Whereas the metric system of weights and measures is the simplest system yet devised and used almost exclusively in 36 nations of the world: Now therefore be it

"*Resolved*, That the National Congress of Mothers and Parent-Teacher Associations favor the enactment of legislation calling for the complete adoption of metric weights and measures in the best way for all concerned."

The National Congress of Mothers and Parent-Teacher Associations comprises a membership of over 250,000, and is organized in 40 States of the Union.

The opinions of educators in favor of the metric units are so well known that it is needless to present more than a representative selection:

P. P. Claxton, when United States Commissioner of Education, Washington, D. C., (May 11, 1920): "Because of its general use in scientific investigations and writings, its wide and increasing use in commerce, its ease and economy in time, money and labor in making calculations in its terms, and the large saving in the time of children in learning it and of school funds in teaching it instead of the complex and unscientific measurements now in common use, I am most heartily in favor of the general adoption of the metric system of weights and measures to the exclusion of all other systems."

George E. Vincent, former president University of Minnesota, and president of the Rockefeller Foundation (December 12, 1919): "With the metric system I am personally in hearty sympathy."

David Starr Jordan, president emeritus, Stanford University, Calif.: "All weights and measures serve convenience; the metric system being decimal is incomparably most convenient, and would make its way at once if officially proclaimed. The old system only holds on by the curious clinging to antiquated forms inherited by America from England. We should by all means adopt the world system."

David Prescott Barrows, president of the University of California, Berkeley, Calif.: "I favor effort to secure adoption of the metric system by the United States in the interest of our commerce, our science, and our common life."

University of Oregon, Eugene, Oreg., through P. L. Campbell, president: "The faculty of the University of Oregon respectfully urges that the metric system be adopted by the Congress of the United States of America and by the British Parliament as the exclusive legal standard of weights and measures."

C. M. Farmer, professor of natural sciences, Lynchburg College, Lynchburg, Va.: "It seems to me that in setting forth the case with which the metric system can be learned and used college students in science could be cited as an effective example. Starting with no knowledge of these units, in an incredibly short time they develop a remarkable familiarity and skill in their use. In Lynchburg College there is not a yardstick, foot rule, pound weight, or gallon, used in demonstration, or in our science laboratories. The metric units are used exclusively. When students want to translate they are told that it is desired that they get the 'poison' all out of their system and think in terms of metric units only. The same familiarity and 'feeling' for the metric units as college students so quickly would, in a very short time, obtain among people generally."

William B. Bentley, head of the department of chemistry, Ohio University: "All scientific men are interested in the metric system. No greater good could come to American manufacturers in their efforts to become a principal factor in South American trade. In fact, meter-liter-gram is absolutely necessary."

J. B. Woodworth, chairman, department of geology and geography, Harvard University: "All the earthquake stations use the metric system in reporting and calculating the data regarding near and distant earthquakes."

Albert Bushnell Hart, expert in Government at Harvard University: "The metric system is one of the world's conveniences. It was recognized by the United States of America 100 years ago in coinage. It is almost essential for the expansion of our world trade, avoiding millions of errors in calculations and changes. The country should take immediate steps toward its adoption as the standard."

R. P. Bigelow, librarian, Massachusetts Institute of Technology: "I thoroughly approve of the universal use of the metric system and should be glad to support a movement toward the universal adoption of that system."

M. E. Ahern, librarian, Public Libraries, Chicago, Ill.: "I am glad to see concerted action on the part of the business men to support this measure. It seems a most propitious time for action along this line when thousands of boys have returned from France speaking of kilometers, liters, meters, and so on."

Carrie Chapman Catt, educator, president National American Woman Suffrage Association (Mar. 8, 1921): "I am myself very heartily in favor of a standardization of weights and measures for the world."

Frederick A. Spafford, Flandreau, S. Dak. (Feb. 20, 1921): "The regents of education of the State of South Dakota, of which I am a member, sent a memorial to our Congressmen asking that they support metric standardization of weights and measures."

Melvil Dewey, preeminent librarian and originator of the Dewey decimal classification, founder of New York State Library School, former chancellor of

the University of the State of New York (Mar. 5, 1921): "I am hammering for the metric cause wherever I get a chance."

Walter Scott Perry, director Pratt Institute, Brooklyn, N. Y.: "The movement for metric standardization ought to have a great influence for good."

L. J. Paetow, professor of history, University of California: "The meter-liter-gram system will supersede our present barbarous system of weights and measures as certainly as the day follows the night."

Albert Shiels, former superintendent of schools in Los Angeles, Calif., and in New York City: "The adoption of the metric system would greatly simplify the whole problem of instructtion among the children of the Nation. Our curriculum is overloaded, and the saving of thousands of hours now devoted to the clumsy and complex arithmetic of the present type could be used for other educational purposes."

T. F. Phillips, head of the department of science, Duluth Central High School, Duluth, Minn. (Sept. 10, 1919): "Next to the World War, adoption of metrics would be the biggest thing America ever did."

John H. Muykeus, professor of phonetics, Kennedy School of Missions, Hartford, Conn. (Feb. 23, 1920): "In France I learned that the children 10 years of age in computing arithmetic problems arrived at the correct result with greater ease than the ninth and tenth grade pupils in our country who are compelled to use our present hodgepodge of weights and measures. * * * We live for our children, or we have not understood either life or American institutions. Let us adopt the metric system—let standpatters kick!"

Thomas A. Edison, world's greatest inventor: "Make a child study what it does not like, and keep this up until it is 14 years old, and its brain is impaired forever." (Edison's denunciation of what he calls "our present jumble" of weights and measures has been quoted elsewhere.)

Elias Silberstein, principal in New York public schools: "I have always felt that at least a year could be saved in the arithmetic course if the archaic system of weights and measures was supplanted by the decimal system."

Florian Cajori, professor of mathematics, University of California: "It is a paradox that a nation in most respects so progressive as is the United States should be so far behind in the adoption of the metric system. Even little Switzerland has been able to make the change. Educationally, the gain would be great. The time is approaching when commercial considerations demand adoption."

Isaac Taylor Headland, professor of missions, Wesley College, Alliance, Ohio, author on China, and Chautauqua lecturer: "For several years past in one of my lectures on China I have given expression to the following sentences: 'We have the worst system of weights and measures in the Christian world, a system in which we compel our children to learn that there are 16 parts, or 8 parts, or 4 quarters in an inch, and 12 inches in a foot instead of 10, and 3 feet in a yard, and 5½ yards or 16½ feet in a rod. Why could we not make a rod with an even number of feet in it and make arithmetic easy for the children? Then we have 16 ounces in a—or 12 ounces—how many ounces do we have in a pound? And we could not make a pound with a definite number of ounces in it—and we can not discard this old system for a metric system that is already made to our hand. And England, with the worst monetary system in the Christian world—her pounds, shillings, pence—a system which she recognizes to be so bad that she will not advise a single colony she establishes to adopt it. And she can not discard it. Yet since I went to China (1890) she has discarded an educational system which she spent 1,000 years and more in developing, the basis of which was Confucianism, and has adopted the system introduced into China by the missionaries from Europe and America!' Can not we rise to the progressive spirit of China, and adopt the meter-liter-gram and make mathematics easy for our posterity? With all my heart I approve of the exclusive use of the 'meter-liter-gram' by Great Britain and the United States of America, my father's country and my own, and I would be willing to devote all my energy to the bringing about of such a change."

Theodore Hough, dean of department of medicine, University of Virginia, Charlottesville, Va.: "I regard this adoption of the metric system by the English-speaking world as a very urgent matter."

D. N. Lehmer, professor of mathematics, University of California, Berkeley, Calif. (February 19, 1920): "I shall leave no stone unturned in educating the youth who are to be our business men as to the stupidity and folly of clinging to our chaotic jumble of units."

Michigan State Normal College, through C. P. Stemle, secretary-registrar (February 13, 1920), unanimously favors legislation that will bring about the exclusive use of metric units by the United States of America.

F. I. Cooper, chairman committee on standardization, National Education Association (February 18, 1920): "I am thoroughly in favor of the use of the metric system. I shall do what I can to urge its general adoption."

W. C. Brown, superintendent Louisville Industrial School, Louisville, Ky.: "As an educator in the class room and as an administrative and executive officer of schools and institutions, my observation and experience impels me to the conclusion that there should be only one system; and of all the metric is the best adapted for the purpose. In this day of striving for single standards, let us not overlook the sore need for adjustment in this department of applied practical science and economics."

H. V. Arny, professor of chemistry, Columbia University: "World science stands 100 per cent for metric units."

W. N. Gladson, dean of engineering, University of Arkansas: "There is no question in my mind as to the advantages of this system over our present clumsy English system of weights and measures, and the ultimate benefits to be derived by our adoption of the system will outweigh the costs and inconveniences of making the change."

E. W. Kemmerer, financial expert and contributing editor; professor of economics and finance, Princeton University (February 14, 1920): "In my judgment, the nation-wide adoption of the metric system of weights and measures is desirable at as early a date as practicable. The present time, when the entire business world is adjusting itself to new standards would seem to be a particularly opportune time for making progress in this direction."

Joseph V. Collins, department of mathematics, State Normal School, Stevens Point, Wis.: "The learning of arithmetic through the medium of our present crude weights and measures is equivalent of fastening a ball and chain to every child in school. In countries using metric weights, arithmetics are no more than half the size of those in use in nonmetric countries, with a corresponding diminution in the time needed for the study. On account of the so-called enriching of the course of study by the introduction of other studies besides the 3 R's, the time given to arithmetic has been steadily cut down, with a corresponding weakening in the standard of attainment. A great cry has gone up over the country because of the poor preparation of the rising generation in arithmetic. With metric arithmetic in use, the new studies could be retained and the old arithmetic standard brought back.

"The 3,000,000 children that leave United States American schools each year are denied from one-third to two-thirds of a year of additional schooling, dependent on the amount of time given to arithmetic. When it is remembered that added schooling means added earning power, it is apparent that several hundreds of millions of dollars are lost to America every year by the retention of our antique weights and measures that came down to us from the German Hanseatic League. This estimate evidently takes no account of the troubles brought upon innocent childhood in trying to learn a preposterous hodge-podge of numbers and calculations, nor of the children that drop out of school before their time because they can not learn the crazy arithmetic."

There are literally hundreds of thousands of eduators throughout the United States of America working in behalf of the logical metric units. On record with the Department of Commerce, Washington, D. C., there are the petitions of 37,244 educators who urge the gradual metric advance. Many of the names within the present book, especially in the sections on science and engineering, are those of educators; and many more are listed in World Trade Club booklets 1 and 9.

Here are some of the many educators and educational institutions urging exclusive use of meter-liter-gram:

John R. Allen, dean college of engineering and architecture, University of Minnesota.

C. H. Allender, superintendent Gass Lake Indian School, White Earth, Minnesota.

Dr. W. G. Anderson, professor and director of Yale University gymnasium, New Haven, Conn.

G. A. Anderson, president Augustina College and Theological Seminary, Rock Island, Ill.

G. H. Apple, president Hood College, Frederick, Md.

Raymond F. Bacon, Mellon institute of industrial research, University of Pittsburgh, Pittsburgh, Pa.

Milton Bennion, dean school of education, University of Utah, Salt Lake City.

J. R. Benton, dean of the college of engineering, University of Florida, Gainsville, Fla.

Dr. George Blumer, dean of the medical faculty, Yale University, New Haven, Conn.

Board of education, Canton, Ohio.

Board of education, Zanesville, Ohio.

Board of education, Genevieve, Mo.

Charles S. Brown, professor of mechanical engineering, Vanderbilt University, Nashville, Tenn.

Henry A. Buchtel, chancellor University of Denver, Denver, Colo.

W. W. Campbell, director Lick Observatory, Calif.

F. C. Caldwell, professor, department of electrical engineering, Ohio State University, Columbus, Ohio.

Laura A. Carnell, dean Temple Unversity, Philadelphia, Pa.

Frank W. Collier, director of research, American University, Washington, D. C.

Melvin L. Collins, president Louisiana Collegiate Institute, Shreveport, La.

Colorado Agricultural College, Faculty Club, Nellie M. Kilgore, secretary.

A. G. Crane, president North Dakota State Normal School, Minot, N. Dak.

Dr. Harvey Cushing, professor of surgery, Harvard University, also surgeon-in-chief Peter Bent Hospital, Boston, Mass.

Richard D. Currier, president New Jersey Law School, Newark, N. J.

Edward Ellery, dean of the faculty, Union College, Schenectady, N. Y.

Frank A Fetter, professor of political economy at Princeton University.

J. H. Frandson, professor and head of the department of dairy husbandry, college of agriculture and experiment station, University of Nebraska, Lincoln.

Edwin B. Frost, director of Yerkes Observatory, University of Chicago, Williams Bay, Wis.

H. M. Gage, president Huron College, Huron, S. Dak.

Garrett Biblical Institute, Charles M. Stuart, president, Evanston, Ill.

Sidney G. Gilbreath, president East Tennessee State Normal School, Johnson City, Tenn.

Girls' Collegiate School, Los Angeles, Calif.

E. C. Glass, superintendent of schools, Lynchburg, Va.

R. W. Godard, department head, physics and electrical engineering department, New Mexico College of Agriculture and Mechanic Arts.

C. A. Grommet, principal Modern Business College, Los Angeles, Calif.

Ezra A. Healy, dean Maclay college of theology, University of Southern California, Los Angeles, Calif.

Howard Memorial Library, New Orleans, La.

E. V. Huntington, professor of mechanics, Harvard University, Cambridge, Mass.

Thomas F. Kane, president University of North Dakota, Grand Forks, N. Dak.

Vladimir Karapetoff, professor of electrical engineering, Cornell University, Ithaca, N. Y.

Roy W. Kelley, director division of education, bureau of vocational guidance, Harvard University, Cambridge, Mass.

Charles F. Kent, professor of biblical literature, Yale University, New Haven, Conn.

J. T. Kingsbury, president emeritus, University of Utah, Salt Lake, Utah.

D. W. Kurtz, president McPherson College, McPherson, Kans.

A. J. Ladd, professor of education, University of North Dakota, Grand Forks, N. Dak.

Alexis F. Lange, dean school of education, University of California, Berkeley.

James Melvin Lee, editor and now director of the department of journalism, New York University.

William E. Mott, dean school of applied science, Carnegie Institute of Technology, Pittsburgh, Pa.

Harold Bender, professor in charge department of electrical engineering, University of Pennsylvania, Philadelphia, Pa.

H. B. Pulsifer, professor of metallurgy, Montana State School of Mines, Butte, Mont.

G. Canby Robinson, dean Washington University, St. Louis, Mo.
Rock Island Board of Education, Rock Island, Ill.
J. C. Sathre, president Crookston College, Crookston, Minn.
F. E. Searle, superintendent Ford schools, Ford Motor Co., Detroit, Mich.
Carl E. Seashore, dean graduate college, State University of Iowa, Iowa City.
Joseph A. Serena, president William Woods College, Fulton, Mo.
J. Russell Smith, professor of industry, Wharton school of finance and commerce, University of Pennsylvania, Philadelphia, Pa.
W. I. Smith, president Walla Walla College, College Place, Washington.
H. D. Sparks, president of Sparks Business College and Conservatory, Shelbyville, Ill.
E. L. Stephens, president Southwestern Louisiana Industrial Institute, Lafayette, La.
Tampa Business College, Tampa, Fla., through President L. M. Hatton and faculty.
University of Georgia, medical department, Augusta, Ga.
University of Tennessee, college of medicine, Memphis, Tenn.
Patterson Wardlaw, dean, University of South Carolina, Columbia, S. C.
Washington Academy of Science, Washington, D. C.
West Virgina Wesleyan College.
Whittier College faculty, Whittier, Calif.
Charles B. Williams, president, Howard College, Birmingham, Ala.
Marshal F. Winne, president, University of Dallas, Dallas, Tex.
R. H. Wilson, State superintendent of public instruction, Oklahoma City, Okla.
Woman's Medical College of Pennsylvania, Philadelphia, Pa.
C. A. Wright, prefessor, department of electrical engineering, Ohio State University, Columbus, Ohio.
Valparaiso Teachers' Institute, Valparaiso, Ind.
E. F. Warner, high school inspector, State of Ohio, department of public instruction.
Howard Dwight Smith, department of architecture, Ohio State University, Columbus, Ohio.
Frank Dean Tubbs, professor of astronomy and geology, Bates College, Lewiston, Me.
Hamline University, St. Paul, Minn. (unanimously).
Oswald Schlockow, department of education, city of New York.
University of Minnesota Medical School, Minneapolis, Minn.
Women's College of Delaware, Newark, Del., through Winifred J. Robinson, dean.
John M. Dodson, dean of the medical courses, University of Chicago, Ill.
J. C. Nagle, dean of engineering, Agricultural and Mechanical College of Texas.
R. L. Green, department of mathematics, Stanford University, Palo Alto, Calif.
C. R. Bardeen, dean of the medical school, University of Wisconsin, Madison, Wis.
Dean G. G. Pond, Pennsylvania State College.
Charles F. Lanman, expert on Oriental languages, Harvard University.
Rusk Junior College, Rusk, Tex., through M. W. Robinson, dean.
Bruce Bartholomew, Berkeley High School, Berkeley, Calif.
A. J. Eddy, department of civil engineering, University of California, Berkeley, Calif.
Harriett Brandford, dean of women, Stanford University, Palo Alto, Calif.
P. A. Martin, department of history, Stanford University, Palo Alto, Calif.
Lewis E. Johnson, department of civil engineering, Harvard University, Cambridge, Mass.
H. P. Talbot, department of chemistry, Massachusetts Institute of Technology, Cambridge, Mass.
Delos Fall, dean of Albion College, Albion, Mich.
Maxwell Adams, dean, college of arts and science, University of Nevada, Reno.
Arthur G. Fletcher, Proctor Academy, Andover, N. H.
Richard D. Currier, president, New Jersey Law School, Newark, N. J.
Dr. Henry L. Taylor, board of education, New York State, and hundreds of thousands of others.

AUTHORS, ARTISTS, EDITORS, PUBLICISTS.

H. L. West, editor, The Bookman: "I am with you heart and soul in trying to do away with our present absurd system of measurements."

C. W. E. Miller, editor, American Journal of Philology, Baltimore, Md.: "The adoption of the metric standards bill would be an immense step forward educationally, politically, socially and commercially."

Charles Edward Russell, journalist and author, Washington, D. C.: "I am in favor of the metric system and should like to see it adopted by the United States."

Margaret Deland, noted author; Kennebunkport, Me.: "The world standardization of weights and measures, through the adoption of metric units by America and Britannia would go far toward stabilizing the peace of the world, because it would contribute to a commercial understanding which our differing standards of weights and measures has heretofore made impossible."

John Spargo, noted author and lecturer; Old Bennington, Vt.: "I have no hesitation in saying that I believe the adoption of your proposal would tend to make international intercourse more easy and more efficient than it is now. As a general proposition, uniform methods of trade communication are helpful in promoting international understanding. Certainly our own weights and measures are very antiquated and the British very much worse."

Bliss Perry, author, and professor of English at Harvard University: "The arguments for adopting the metric system are unanswerable. The obstacle is simply the traditionalism, complacency and inertia of our fine old crusted Anglo-Saxon habits. Every consideration of scientific efficiency and commercial progress is in favor of a world system of measurement."

G. O. Oakes, editor, Current History Magazine of the New York Times: "Personally the writer warmly favors the metric system."

Henry Smith Williams, noted scientist and contributing editor; New York City (February 3, 1921): "I am glad to cooperate in any way possible."

Dr. Frank Crane, the noted journalist and editorial writer for the Associated Newspapers which reach more than 10,000,000 people: "We have international systems of time, longitude and the like. The metric system of weights and measures is the only system adapted to world use, and has already been almost universally adopted. Why de we not take it up? The chief advantage is that it has the decimal ratio. By it a child can learn to measure wheat or water or land or distance as easily as he now learns to count money. We need to agitate public sentiment until Congress inaugurates its nation-wide adoption."

Arthur Brisbane, distinguished editorial writer; editor, Chicago Herald and Examiner: "It would be perfectly simple to put into effect the metric system which would make it possible to multiply and divide bushels, quarts, pecks, ounces, grams, and pounds, by striking off or adding a zero, just as you now multiply or divide sums of money."

Herbert Adams Gibbons, famous war correspondent, lecturer and author; writing in the Philadelphia Press: "Very soon we are coming to the realization of the handicap of the British system when we go in for world trade. The handicap may well prove fatal to us. It is time now that chambers of commerce and all who are interested in foreign trade join in the demand for abandoning the British standards of weights and measures in favor of the world-wide meter-liter-gram. For the sake of keeping pints and quarts and gallons, inches and feet and yards, ounces and pounds and tons, Americans lose a lot of time each year in calculations that are wholly unnecessary, when they might be simply moving the decimal point. Among the names of advocates of the meter-liter-gram, we see Alexander Graham Bell, Lord Kelvin, Samuel Vauclain, Theodore Roosevelt, Thomas A. Edison, Luther Burbank, Henry Ford, General Pershing and virtually all the great manufacturing concerns of the country."

Writing from his home in Princeton, N. J., Herbert Adams Gibbons says: "As to the importance of changing our stupid system of weights and measures, I could give numerous instances of trade lost by Great Britain and the United States by our lack of a uniform system with the rest of the world. Who works for the abandonment of our present system of measures works for world peace, and also for the advancement of American commerce and American culture throughout the world."

Floyd Gibbons, noted war correspondent for Chicago Tribune, Paris, France (February 2, 1920): "The reason why the United States doesn't change to

counting in pence, shillings, and pounds is the same reason the United States should have the full metric system."

Sherwin Cody, noted author of "Personal development service," Forbes Magazine; managing director, Business Standards Association, New York City (February 26, 1920): "There is no question that the metric system is a great time-saver, and is well on the way to becoming the world standard."

Frederic J. Haskin, director, The Haskin Letter, Washington, D. C., in article, "The needed meter": "If you do not understand the metric system of measurement, look it up and learn it. For there are strong indications that the meter and liter and gram will soon displace the yard and quart and pound in all your dealings."

George F. Weeks, editor, The Mexican Review, Washington, D. C. (September 16, 1921): "Having lived in Mexico some 15 years, I am a believer in the metric system."

Among the many authors, artists, editors, and publicists who are urging the decimal metric units may be mentioned:

Henry Van Dyke (quoted elsewhere).

Franklin W. Calkins, author (one of chief contributors to The Youth's Companion), Aladdin, Wyo.

Grace Ellery Channing, author, New York City.

Edmund Vance Cooke, noted contributor to the leading periodicals, Cleveland, Ohio.

Herbert Coolidge, author, Santa Barbara, Calif.

Herbert S. Houston, vice president, Doubleday, Page & Co., and president, Associated Advertising Clubs of the World, 1915, 1917.

Sterling Heilig, Paris, noted war correspondent.

E. B. Filsinger, New York City, world trade contributor to technical journals.

William Howard Gardiner, New York City, eminent author on Pacific problems.

George Wharton James, Pasadena, Calif., noted author, explorer and ethnologist.

W. R. Harris, editor, Highway Engineer and Contractor, Concrete Products, also associate editor, Engineering World.

Reginald Wright Kauffman, novelist, war correspondent, Columbia, Pa.

George Whitefield D'Vys, author, Rowe, Mass.

Charles Johnson Post, journalist, artist and editorial writer with the Associated Press and many leading periodicals, New York City.

Julian Ralph, much-read American author.

Cuyler Reynolds, Albany, N. Y.

Marshall Saunders, Greenfield, Ohio, author of Animal Stories.

H. H. Windsor, editor and publisher, Popular Mechanics Magazine, Chicago, Ill.

Henry Beets, author and editor, The Banner, Grand Rapids, Mich.

William Henry Bishop, author, Brooklyn, Conn.

Gardner Hunting, author and production editor, Famous Players Studio, New York City.

Percy Ives, eminent artist, Detroit, Mich.

Robert Voonoh, eminent painter, New York City.

Charles Rohlfs, designer, Buffalo, N. Y.

Albert Jaegers, eminent sculptor, Suffern, N. Y.

Francis Edwin Elwell, eminent sculptor, Weehawken, N. J.

V. Stefansson, noted Arctic explorer and author, New York City.

Gordon Strong, Chicago, Ill.

Allen Brett, editor, Better Business, Cleveland, Ohio.

PUBLICATIONS, PERIODICALS, NEWSPAPERS.

Thousands of publications throughout the United States of America are participating in the discussion of the world metric standardization movement. The World Metric Standardization Council has in its files at least 10,000 clippings from newspapers and periodicals, from which the following selection is made:

New York Sun (May 7, 1919): "The world is in a frame of mind for such unifications and standardizations. Moreover, the great international trade of the future is entitled to the simplest, most economical processes."

Daily Herald, New York and Paris, in a metric campaign (1905-6) published daily columns of interviews. Thousands advocated exclusive use of meter-liter-

gram. "All trades and industries would be benefited by the adoption of this standard which is uniform, accurate, and easily understood, adapted to every practical use, and known and accepted throughout the civilized world."

Public Ledger, Philadelphia, Pa. (March 23, 1921); Men and Business, by Richard Spillane: "Mark Twain once remarked that everybody complains about the weather but nobody does anything. Everybody who has anything to do with three of the great departments of international affairs—money, weights and measures, and languages—complains about the confusion and waste attending them, but nobody does anything to correct them, except at rare intervals, such as that started a few years ago in regard to making the metric system universal."

Evening Mail, New York, N. Y. (January 30, 1918): "We are adopting the metric system piecemeal. We did a good thing for ourselves when we applied the decimal system, a phase of the metric system, to our currency. Any proposal to reject that system now and revert to the anarchic arbitrary method of computing money would be laughed to scorn.

"But, with a backwardness which is wholly at variance with American traditions in almost every other respect, we cling to the old, inconvenient, unreasonable and utterly inexcusable measures of weight, distance, and volume. And now we have made a concession to the modern spirit under the stress of war. The War Department has adopted the metric system of measurements for artillery, machine guns, and maps for the American oversea forces, because it was asked by the French Government to eliminate the danger of confusion in our co-operation with France, which uses the metric system throughout.

"The request of the French Government has battered down one of the walls which we have built around our arbitrary and antiquated system of measurement, and which we have stoutly defended against all the world. Let us take up the excellent work which our ally and historic friend has so auspiciously begun. Let us throw out and promptly forget every ounce, pound, ton, pint, quart, gallon, inch, foot, and mile we ever knew, and let us adopt the most logical, the most perfect, the most convenient and the most reasonable system of measurements in the world—a reckoning based upon the numerical system itself."

Examiner, Los Angeles, Calif. (August 7, 1919): "There are many grave matters of preparation that are being neglected. One of the most important of these is the necessity at once to free our commerce from the handcuffs of mediaeval terminology by adopting the metric system of weights and measures.

"All of the countries with which we hope to develop a commerce, easily within our grasp if we treat the problem with sense and science, use the metric system, with a single exception of the British Empire. That power, like our own, sticks to its own old provincial system, which by no means is identical with the equally archaic American.

"In his first message to Congress President George Washington urged the adoption of the metric system. It is not yet too late to accept his advice. Only we should be foolish to wait any longer. The metric system was a prime factor in giving Germany the cream of Latin American trade, because Latin America is 100 per cent metric and does not understand any other system of weights and measures."

Tribune, Chicago, Ill. (June 27, 1919): "Our present system of weights and measures has no support except tradition. It is a tradition inherited from our English ancestors, but every American scientist prefers the metric system and, as a matter of fact, no other system is used for scientific work. Our currency is founded on the metric principle, and its convenience is obvious to every one. We probably do not realize how much time and trouble is involved in using our present standards of length and mass.

"There is, however, a more immediate reason why we should adopt the metric system. Every South American country now uses this method of designating weights and measures, and for this reason they find it easier to trade with European countries, where the metric system was long since adopted. If we want to develop trade with South American nations, we shall find it is of the greatest advantage to make our system conform to theirs." The Chicago Tribune, on July 13, 1919, said: "A correspondent urges the adoption of the metric system. We are for it."

Middletown Journal, Middletown, Ohio (July 30, 1919): "The World Trade Club has started the ball rolling in the right direction. What we all need is to familiarize ourselves with the proposed system. A thorough knowledge of it will dispel all opposition to it.

The Argonaut, San Francisco, Calif., has petitioned the legislators of the United States of America and the British Commonwealths for exclusive use of the meter-liter-gram.

Evening Transcript, Boston, Mass., through J. E. Chamberlain: "The Transcript is advocating the metric system."

Times, Los Angeles, Calif. (March 5, 1920): "The transition from former systems of calculation to the simpler forms of the meter, liter, and gram was made in the various countries adopting it without serious difficulty or delay. The system once adopted here would prove as simple and as workable as our decimal currency."

News-Tribune, Detroit, Mich. (February 6, 1920): "Favorable action by this country would place our people in commercial harmony with a world of opportunity. We ought to get upon the wagon of progress."

Christian Science Monitor, Boston, Mass.: "The question of weights and measures is preeminently a subject which can not and ought not to be treated lightly. It is fairly safe to say that no one, unless he has some specific reason for securing the information, has any idea of the enormousness of the Anglo-Saxon system of measurements, in every sense of that word.

"The foot-pound-second advocate makes a great show of simplicity. Weights and measures are as simple to him as ever education was to the advocate of the three 'R's.' But behind the foot-pound-second, there are the many complications which he never mentions, apothecaries' weight, apothecaries' fluid measure, diamond and pearl weight, to say nothing of no fewer than 49 other 'miscellaneous' weights and measures."

Odessa Herald, Odessa, Tex. (August 2, 1919): "Once Watt's simple system is officially adopted, the change in the formula of our arithmetics will be so radical that mathematics will cease to be the holy terror that it is now to the average pupil, and become a favorite study."

Republican, Midland, Mich (August 28, 1919): "Why not have a decimal system of weights, measures, and the whole business as well as in money—one principal unit of each sort, then a period (.) and the subdivisions in order of tenths following? Addition, subtraction, multiplication, and division would then be just as simple as in case of money amounts."

Tirbune, Sioux City, Iowa, through John C. Kelley, manager: "There can be no doubt that a universal standard of measurements would promote commerce and advance civilization."

Scientific American, New York City (September 17, 1921): "Metric weights, now obligatory on Chinese railways, are said to have given rise to no trouble or complaint. The metric system went into force in Malta on July 1. A chart issued by the Decimal Association shows consistent gains for the system during the past 100 years, with a particularly sharp rise in popularity in the last 10 years."

Commerce and Finance, New York City (September 21, 1921): "The Metric Association was there (at the Chemical Exposition) showing us the silly waste of human energy and the confusion resulting from our antediluvian weights and measures which give pupils in our public schools brain fag before their time."

Times, Washington, D. C.: "There is positively no doubt that the metric system is far more rational and more convenient than the system we now employ. The practical benefits of the metric system to us would be a great saving of time in memorizing tables and in calculating weights and measures; the use of a system interrelated and the adoption by this country of an international system." On April 25, 1920, the Washington Times said: "It seems impossible for us to realize the stupidity of the Chinese sticking to their preposterous alphabet, until we happen to remember that we hang on to our idiotic system of weights and measures instead of adopting the decimal system. That helps us to remain modest."

Times-Union, Rochester, N. Y. (October 28, 1921): "The installation of the metric system would cause confusion for a time, but ultimately it would be of great benefit and save endless toil. By all means let us have it."

Hearst's Magazine, September, 1919.—Common-sense measurements: "When an American pays his first visit to England, he is sure to come away with very pronounced ideas as to the absurd monetary system there in vogue. The use of so cumbersome a system as pounds, shillings, and pence strikes him as inherently absurd. He hears it related that two or three bookkeepers are required in an English business house to do the work accomplished by one in America, owing to the difficulties of computing percentages according to this cumbersome

system. And yet when the same American goes over to the Continent and attempts to do a little shopping, he is as much annoyed by the meters, liters, and grams of the tradesmen as he was by the pounds, shillings, and pence of the British; and he wonders why the continental can not deal in simple units like yards, pints, and pounds.

"All of which indicates the power of preconception. For of course the meter-liter-gram system is a decimal system, having all the advantages over the antiquated system of yards, pints, and pounds that the system of dollars and cents has over the cumbersome coinage of England. It chances merely that continental Europe (and practically all other parts of the world except England and the United States) long ago adopted the plan of making a logical application of the decimal system all along the line; whereas we have agreed with our British cousins in refusing to accept the simple and effective system, holding obstinately to our antiquated methods in favor of which nothing whatever can be urged except the fact that we are accustomed to them."

Popular Magazine: "We are rooters for the metric system, and so we were glad to see that the World Trade Club of San Francisco has inaugurated a vigorous campaign to have it adopted by the United States. Our present weights and measures are a relic of the medieval Hanseatic League. James Watt invented the metric system, but the Anglo-Saxon race from which he sprung is the last to adopt its own genius in this important matter. Like ourselves, Great Britain still clings to the unscientific old Hanseatic plan."

The Christian Register, Boston, Mass. (August 7, 1919): "The World Trade Club of San Francisco, Calif., deserves credit for its far-reaching campaign to induce America and England to adopt the metric system. Britain still retains a very primitive method for the reckoning of money values. The United States has adopted the metric system for money, and any one who has experience in both countries knows with how much more facility change can be reckoned by the United States system. Both the United States and Great Britain, however, still adhere to the very ancient system forced upon England many years ago by the German Hanseatic Trading League. The new demands of peace should insistently urge us to the adoption of the sensible metric system. It already has been adopted in medicine, pharmacy, optometry, photography, physics, chemistry, astronomy, electricity, and aviation."

Rough Notes, Indianapolis, Ind. (August 7, 1919): "The agitation in favor of the metric system in the United States deserves support and encouragement. The war showed England and the United States the real danger involved in having standards of measurement which varied so greatly that it was practically impossible for the two nations to harmonize their war activities along mechanical lines. For years the bunglesomeness of our standards of measure, aside from currency, have been recognized by the people of the United States. Now that we are facing a new era of international development in our business relations with other countries, it would seem hardly possible that we could make much progress without changing our national standards of measurements to the metric system which is that of the majority of nations with which we will have dealings. Now is the time for making such a change, it would seem, and insurance interests, which are beginning to look beyond the borders of our own land for future development, would do well to lend the weight of their organized influence to the end of better equipping ourselves for the new commercial conquests which we contemplate."

Chamber of Commerce and Board of Trade Journal, Scranton, Pa., August, 1920.—Saving the Nation's Cerebration: "Who will ever calculate in life lengths the time wasted in the highest paid branch of engineering by the use of utterly unnecessary processes of multiplication and division, with an infinity of factors, and the checking and correcting of errors?

"Our brutally arbitrary standards of feet and inches having no basic relation to our gallons and pounds, what a complex process it is to reduce cubic feet to gallons or pounds? Our foot is supposed to be the length of an English King's foot, although there were some Kings more generously endowed than others with both feet and understanding. The gallon and the pound have not even this poor basis to build upon.

"How different it is with the metric system in which there is nothing arbitrary and no two things unrelated! The meter, the one ten-millionth part of the quadrant of the Paris meridian, is directly related to the liter, the standard of capacity, which is a cubic decimeter, and the gram, the weight of a cubic centimeter of water at 4° C. How different are the meter, the liter, and the gram

when compared with our foot, gallon and pound. How easy it is to reduce meters to liters and grams as compared with the kill-brain process of converting feet into terms of gallons and pounds!

"How much more difficult it is to multiply or divide by 62½, 268.8, 537 6, 2150.42, or 1.244, when we wish to reduce a given quantity into pounds, pecks, bushels, gallons, inches or feet, than the mere changing of the position of a decimal point!

"How few can tell off-hand how many cubic feet or inches in a peck, a bushel, or how many pounds in a cubic foot of water? How many college graduates can tell you? Recently when an engineer testified in court that a cubic foot of anthracite weighed 54 pounds not a single judge or lawyer questioned the accuracy of the statement until a miner in the audience said in a stage whisper: 'He's thinkin' av Ivory Soap!' Yet a French school boy will convert liters and decimeters into grams at your will. Oh, the brutal waste of the life of holy childhood in learning these endless tables designed by madmen dead and damned!

"Let us have the rational metric system, which is as far ahead of our fogy measures as the harvester is beyond the sickle, or the electric motor is in advance of the ox. Why should we lag behind the Latins under the coercion of custom and the ghosts of other days?"

Entomological News, Philadelphia, Pa. (June, 1919)—A League of Nations means the metric units. "A few years ago we published an editorial in the News indorsing efforts made in the House of Representatives to enforce the use of the centigrade thermometric scale in United States Government publications. The strongest argument for such action was that the centigrade scale was already in well nigh universal use.

"The progressive World Trade Club of San Francisco is urging the United States (the only large Nation not using the meter-liter-gram system) to take advantage of the present opportunity in the world's history and legalize the exclusive use of the metric system of weights and measures. The same reason for this change exists as is the case in the matter of thermometry.

"As entomologists we have been giving the size of insects in millimeters for many years, and when we go back to some old description and have to translate 'lines' or some other antique unit, into modern equivalents, we feel a sinking of the heart. Let us, in these days of a League of Nations, internationalize our standards of measurement as well as our political relations. Let every one urge his Congressmen to do their utmost to accomplish this result."

The Steward (Bulletin of the Stewards' Association, New York), October, 1919: "In an editorial in our July issue we told of the campaign which the World Trade Club of San Francisco is conducting in favor of metric units, meter-liter-gram. The Stewards' Association of New York City has indorsed the project in open meeting and has forwarded petitions asking for legislation that will bring about the exclusive use of the meter-liter-gram by the United States of America as well as England."

T. E. Willson, editor, the Jewelers' Circular, December 20, 1919): "After the decimal carat, with a basis of 200 milligrams, was adopted by the jewelers' trade there was hardly a man, old or young, who would have considered for a minute the question of going back to the old carat, and its divisions of half, quarter, thirty-seconds, and so on. The rapidity with which the old system went out was really astounding."

Popular Mechanics, Chicago, Ill. (August, 1919): "To change any custom which has had universal use in a country for centuries seems revolutionary, and suggests all sorts of difficult problems. We like our inches and feet just as the native in some lands to-day likes his antiquated wooden plow which has the sentiment of centuries of use. In some of our older cities, certain streets wind about, resulting in buildings of irregular and undesirable shapes, because years ago a cow path followed the direction of least resistance. Some of these freak streets have already been corrected, and no new ones are laid out so. Our present system has no better excuse for being continued, and should be changed. Any person of ordinary intelligence can learn the metric system in an hour, and school children will master it in a fraction of the time now required to learn the present tables."

Tobacco, New York (August 28, 1919): "The World Trade Club, particularly has been right on the job. Copious literature issued by the club has shown with relentless logic the need for world standardization of weights and measures, and the gain the metric system would bring to the United States in trade, in manufacture, in education.

"Now is the time to remedy the error. The World War showed us that all the world except the English-speaking peoples depended upon the simple, logical, and efficient metric unit standardization. The United States and Britannia could not cooperate effectively with their Allies until they had adopted metric standardization for war purposes.

"Write to-day. A postal will do it. Write your Senators, your Congressman. Get the thing done."

Dry Goods Economist, New York City (May 24, 1919): "As far back as the early nineties of the last century the Dry Goods Economist printed a series of articles showing why the change was advisable for the United States. And if such a change was advisable a quarter of a century ago, it was surely essential in these days, when the world has shrunk, when our relation with other nations have broadened and when our opportunities for foreign trade are greater than they ever were before."

The Inspector (official organ American Society of Mechanical Inspectors), editorial by Henry F. Winter (September 15, 1919): "Now is the most opportune time to adopt the metric system.

"Standardization can not be complete under the present English system. The only argument against the metric system that posseses any logic, is the fact of the losses to be faced in the changing of equipment. These losses must be faced sooner or later, and the said losses multiply while we dillydally with technicalities.

"I truly believe that if the late Theodore Roosevelt had been in power during the past war the metric system would to-day be a reality.

"National Security demands the metric system.

"Industrial supremacy demands the metric system.

"Common sense demands the metric system.

"Now is the last real psychological and economic era in which to establish for once and for all this system of such momentous necessity to the Nation individually and collectively. No more debative delinquency can be tolerated. It must be now or never. Every manufacturer must focus his attention beyond what present losses would be sustained. If not from a patriotic standpoint, then surely from the most mercenary deduction we must visualize the future. And no thinking man can dare oppose for a single moment the inevitable.

"If a few leading manufacturers would publicly announce their intention to adopt the metric system at a predetermined date in cooperation with Governmental aid and also with the cooperation of the various engineering societies. everybody would fall into line. What is needed is but a real leader; an aggressive, progressive, constructionist with proper organization behind him to compel national action. The time for reviewing technicalities has passed. We have argued pro and con for years with the results that the metric system has been unalterably proven and indorsed universally.

"Nothing short of action is now in order. Conservative but aggressive action."

International Cinema Trade Review, article by M. H. Shoenbaum (June. 1919): "Are you an exhibitor somewhere in India, Africa, Siberia, London, Paris, or New York? Or are you an exchange man? Perhaps your business is to buy films for other people, or do you prefer to earn your livelihood by producing film or machinery and equipment? Whoever you are and whatever you do, you are losing a certain amount of money every year, either in cash or in time, and the only excuse you have is that you don't know it!

"Have you ever tried to translate dollars into francs, or francs into pounds sterling, shillings, pennies, and farthings? Have you ever attempted to figure out how much you would have paid for your shipment had the bill of lading been based on cubic feet instead of cubic meters? How many precious hours of your life have you spent calculating the cost of so many reels of films measuring each 300, 280, 275, and so forth, meters into so many linear feet? Do you get much joy out of adding or subtracting thirty-seconds and sixty-fourths or changing eighths into sixteenths to render a solution possible? How about wire gage standards: Stubbs steel wire, Birmingham iron wire, United States Standards, Brown Sharpe, Washburn, etc.?

"How about screws? There are the Whitworth pitch, the United States Standard, the bicycle screw, the metric, the International, etc. Leaving aside purely technical matters, don't you think that calculations based on the yard. foot. inch, gallon, quart, and their fractions take too many of our busy moments? America and England, a giant Republic and a giant Empire, are voluntarily remaining behind the rest of the world when it comes to measures and weights. They persist in using a system, or rather a plurality of systems, which, when

put side by side with the decimal system, look like the Chinese writing or printing compared to those of the western world. There is no end to confusion, if neglected. The only remedy to weights and measures confusion is the decimal method of counting; it is the most simple because it does away with the necessity of fractional form."

World Trade, San Francisco, Calif.: Editorial essay by N. A. Davis, publisher (January 2, 1922): "In all seriousness, the present 'system' of weights and measures is a lovely crazy quilt. But then, you see, some folks tell you, it would throw us into 'confusion' if all this wild nightmare of confusion were reduced to simple series of tens, so related that money count, and length, quantity, and weight measures could be reduced to a common factor. Many of the old-school men who cling to time-honored conventions in weights and measures, fear change. The meter-liter-gram advocates sympathize with those good folks, and, as a matter of fact, propose to be as considerate of them as missionaries are said to be of a polygamous Negro chief when converted to Christianity. The practice, we are informed, is not to force the chief to bring in a nice new one and throw out the old hags, but to maintain the crowd and marry no new ones. As a result no one is hurt and very soon polygamy is displaced by the more modern system. So we say, let those who are wedded to their medley measure methods keep their old hodgepodge. But let us have no new institutions handicapped in this way. And let us, after a transition period of 10 years, universally describe things in the world metric language, understood everywhere. The metric system is inevitable. The sooner we have it the better."

World Salesman, a monthly journal of international trade, through Roderic Penfield, American representative: "The World Salesman has been advocating metric standardization for some time. We are thoroughly in agreement on the matter of standardizing a system of weights and measures throughout the world, and in fact believe that the standardization of many things in universal use would be of the greatest advantage."

Tech Engineering News, published by the alumni and undergraduates of the Massachusetts Institute of Technology, Cambridge, Mass. (November, 1921): "The metric weights and measures constitute a scientific system; our system is a disorganization. It is now generally admitted by the majority of intelligent persons in this country that the metric system is a much simpler and better system than that based on the customary Anglo-American standards. The metric system is an international system in the sense that it is employed in all accurate scientific work, in America as elsewhere, and also that it is in use in everyday life in all civilized countries excepting America, Great Britain and its colonies.

"The first step should be to bring commercial organizations of this country to a realization of the fact that our present system of standards is injurious to our foreign trade. The importance of the use of the metric system not only in foreign commerce but also at home is becoming recognized. It is necessary to us because a large part of the world with which we carry on commerce has adopted it. Commercial organizations must be brought to realize that the present system is very wasteful of our most precious commodity—time. The saving of time brought on by the use of the metric system would repay the annoyance brought on by the change.

"We have observed the fact that a change to the metric system is needed for the sake of foreign commerce. We are encouraged by the fact that several large chemical concerns are now using this system as a business basis. In addition we now see that we need it also in general commercial and manufacturing transactions. If we are to have the efficiency so insistently demanded by the age in which we live, then we must have the metric system in use for the ordinary affairs of daily life of the mass of the people, we must have it in education, and we must have it in commercial and manufacturing industries. If efficiency is to be the slogan of this country then the metric system must come, no matter what obstacles stand in its way."

Among the periodicals and newspapers which have published editorials or articles urging metric standardization are: American Grocer, New York City; American Zinc and Lead Journal, Joplin, Mo.; Amerika Esperantisto, official organ of the Esperanto Association of North America; the Casket, New York City; Democrat, Wichita, Kans.; Courier-Citizen, Lowell, Mass.; Educational Review, New York City; Farm and Dairy, Salem, Ohio; Hardware Review, New York City; Gazette, Berkeley, Calif.; Harlem Magazine, New York City; Hudson Dispatch, Union, N. J.; Journal of Electricity, San Fran-

cisco, Calif.; New Jersey Law Journal; Northwest Medicine; Oil, Paint and Drug Reporter, New York City; Pacific Ports, Seattle and Los Angeles; the Polytechnic, Troy, N. Y.; the Popular Engineer, Bernharts, Pa.; Pacific Poultryman, Seattle, Wash. (P. W. Harris, editor and publisher); International Shipping Digest, San Francisco and New York; Quakertown (Pa.) Free Press; Spokesman-Review, Spokane, Wash.; Tennesseean, Nashville, Tenn.; Tucson Post, Tucson, Ariz.; Valve World, Chicago, Ill.; the Watchword, Dayton, Ohio; Successful Banking, Benton Harbor, Mich.; the Packer; numerous agricultural journals listed elsewhere, and thousands of others.

OFFICIALS AND LEGISLATIVE BODIES.

Throughout the United States of America thousands of officials and others in the public service have urged gradual metric standardization. Typical of the action of legislative bodies is the resolution of the State Senate of Illinois. Similar resolutions have been passed by the State Legislatures of California, North Dakota, Tennessee, Utah, and other States; and the reader is referred to the Congressional Record and the official records of metric hearings in Congress, where they are printed in full. The Chicago City Council on May 26, 1920, passed a resolution unanimously calling upon Congress to enact metric standards legislation. The vote was 66 to 0. (This important document is reprinted in the 1921 record of the Senate hearings on the Ladd metric standards bill.)

In the section on preeminent Americans there are presented the opinions of Cabinet officials in favor of the metric advance. Several statements by United States Senators and Representatives are also given, but more are not here printed because their publication subjects their authors to persecution from antimetric propagandists. Nevertheless, it may be stated that scores of national legislators have given definite assurance to the World Metric Standardization Council that they intend to vote for the metric standards bill when it comes up for a vote in Congress. Some of the typical statements by other officials are here given:

Hugh M. Davis, Governor of Georgia (February 1, 1921): "I favor metric standardization."

J. A. O. Preus, Governor of Minnesota, St. Paul, Minn.: "The advantages of the metric system over the present system of weights and measures are innumberable."

Albert F. Brown, Governor of New Hampshire, Concord, N. H. (February 2, 1921): "I have been convinced for a long time of the desirability of such standardization, and your efforts for securing it have my approval."

C. J. McCarthy, Governor of Hawaii (February 1, 1921): "I am very much in favor of this system."

Leonard Wood, Governor General of the Philippines: "I know and favor the metric system."

P. P. Baxter, president of the Senate, State of Maine (January 18, 1921): "In my opinion, the metric system is, in all respects, superior to the present system, and I should like to see the State of Maine take the lead in urging its adoption."

George Otis Smith, Director of the United States Geological Survey: "The Geological Survey is interested in seeing this most practical and advantageous system of units generally adopted."

Frank L. Polk, when Acting Secretary of State, United States of America (May 17, 1919): "The Department of State believes the adoption of the metric system should be a subject of serious consideration by all organizations interested in world trade."

J. W. Alexander, when United States Secretary of Commerce (1920): "It has seemed to me for years past that we should have a uniform standard of weights and measures, recognized and used by all nations and especially those having intimate commercial intercourse. In the recent world war all movements of troops were measured and expressed in terms of the metric system and it was with no little difficulty that the average reader translated them into miles, yards, and inches, and I am in sympathy with your efforts and favor the adoption of the metric system as a universal system."

A. S. Burleson, when United States Postmaster General (1920): "The proposition for the United States and the British Empire to standardize on the metric system solely is, in my opinion, technically and scientifically sound, and, once accomplished, would universally serve public convenience."

W. B. Wilson, when United States Secretary of Labor (February 26, 1920): "With reference to the movement to secure for the United States of America the general use of the metric weights and measures system, I have to say that I am in favor of the adoption of this system."

Newton D. Baker, when United States Secretary of War (February 10, 1920): "The advantages of such a system are numerous and weighty. I hope some practical way can be found to place the United States on the metric system because of the very great advantage to our international trade which would result from our falling in with the standards which are used and understood throughout the rest of the world."

William G. McAdoo, when United States Secretary of the Treasury: "A very important thing is the adoption of the metric system. It was the most unhappy event that the metric system was ever defeated when it came up here—a monumental mistake. If taken up seriously and applied intelligently we could get it transformed in a few years, and it would do more for the development of trade than anything ever yet attempted."

Fred A. Britten, United States Congressman from Illinois: "I regard the adoption of the metric system of weights and measures by the United States of America as of great importance. I have been greatly impressed with the simplicity and the extensive use of the metric system throughout the world, and am thoroughly convinced that it would be best for the people of the United States. The metric system is already used more widely than any other system of weights and measures, and is the standard for science the world over. Its universal adoption is inevitable."

Alexander T. Connell, mayor of Scranton, Pa.: "It seems to me that the meter-liter-gram system, being indorsed by such prominent business and professional men, should have easy sailing in Congress."

C. B. McBrayer, mayor of Shelby, N. C. (November 22, 1919): "I wish to go on record as being strongly in favor of metric units and I shall gladly favor and indorse any legislation which will bring about the exclusive use of meter-liter-gram by the United States of America."

C. C. Nelson, Mayor, Salt Lake City, Utah. (January 8, 1921): "The individual members of the board of commissioners personally favor the adoption of the metric system and feel that the provisions of the proposed law are such as to make the change without doing violence to any line of business."

Samuel C. Dunlap, when commissioner of the Georgia State Bureau of Industries and Immigration: "A change in our system of weights and measures has been too long delayed. No greater step can be taken in the direction of commercial development."

Duncan U. Fletcher, United States Senator from Florida: "I think it would be advisable to have standardization of weights and measures. It would be well to adopt the principal units—meter-liter-gram—at least they should be used in all foreign transactions."

Joseph Irwin France, United States Senator from Maryland: "I appreciate the importance of the subject of metric standardization of weights and measures to those engaged in foreign trade and the advantages which the metric system holds over the system now in use."

C. S. Thomas, when United States Senator from Colorado (September 15, 1919): "The standardization of weights and measures is too obviously necessary for comment."

William C. Lovering, when Representative in Congress from Massachusetts: "I favor the metric system because it is a system. The weights and measures which we now use are not a system. With the Government employing the metric system, after two or three years the country at large will have an object lesson in the benefits of a real system of weights and measures which will give great force to the movement for its adoption. The opposition, such as there is, to the metric system, comes from persons who have never studied it. I have never met a fair-minded man, if he was familiar with it, who declared himself against it." (Representative Lovering was extensively interested in cotton manufacturing.)

J. H. Southard, when chairman of the Committee on Coinage, Weights and Measures, United States House of Representatives: "It is frequently charged by those opposed to the metric system that its advocates are dreamers and theorists. On the contrary, it is my experience that those who are opposed to it are those who are unfair. I have been a member of the Committee on Coinage, Weights and Measures for many years, and have thus come in contact with many who are for, as well as some who are against, the metric system. I have met with but one or two persons during this time who assumed to be familiar with

both systems who were not unequivocally for the metric system. Practically all those who have used both systems extensively give decided preference to the metric."

J. S. Edwards, manager, agricultural section, Division of Traffic, United States Railroad Administration, Washington, D. C. (December 22, 1919): "My observation and experience is that the adoption of the metric system will be a good thing for the United States of America."

John Koren, chairman, department of statistics, Boston, Mass. (May 14, 1919): "Of course, I am glad to help on this metric movement, as anyone who has given the subject thought must be."

John H. Sullivan, city superintendent of weights and measures, Newark, N. J. (March 14, 1920): "If the metric system is adopted the short-weight problem will be solved forever."

Philip Holland, American consul, Basel, Switzerland: "I am one with all the other American consuls abroad that we should adopt the meter-liter-gram system."

B. Harvey Carroll, American consul, Naples, Italy: "In more than a score of reports to the department I have taken occasion to advocate the abolition of the imbecility of the English system of weights and measures and the adoption of the metric system." (These statements are typical of hundreds by commercial representatives of the United States of America abroad.)

J. D. Long, executive officer, United States Bureau of Public Health Service, Washington, D. C. (August 4, 1921): "The Service, of course, uses the metric system on account of its standardized units and the greater convenience and accuracy obtained."

Royal Meeker, Commissioner of Labor Statistics, Washington, D. C.; head of the scientific section, International Labor Office, Geneva, Switzerland: "The reason that in the past there has sometimes been a generation between the discovery of a scientific principle and its application to industry lies in the fact that scientific men and technologists have been living in different worlds. The use of science in industry depends largely upon the availability of the science, and this availability depends to a great extent upon the units of measure. It seems to me that the universal adoption of the metric system is inevitable and that this progressive step will be taken in the near future."

E. F. Hartley, chief statistician for manufactures, United States Department of Commerce (March 6, 1920): "The metric system of weights and measures would be of very great value to this office in compiling statistics of manufactures."

Friend W. Richardson, treasurer, State of California, Sacramento, Calif. (February 4, 1920): "By doing away with gallons and quarts and bushels and pecks and adopting the metric system, we learn to speak a world language. The argument for the metric system is irresistable. The fact that we have such ease with handling our money is proof of this."

C. R. Forbes, Director, Bureau of War Risk Insurance, United States Treasury Department, Washington, D. C. (July 15, 1921): "I am glad of the opportunity to add my indorsement to this movement for the metric system of weights and measures; and, being an engineer by profession, I have found that its systematic decimal relations greatly facilitate rapid and accurate mental as well as written calculations. For this reason, together with the fact that three-fourths of the nations of the world now use it almost exclusively, I venture the prediction that the achievement of your most sanguine expectations will be early realized."

John Lind, formerly personal representative of the President of the United States in Mexico; in The Mexican People: "There are important steps which in my judgment are imperatively necessary to insure permanent success. We must get into line with the commercial world in the matter of weights and measures. I asked an intelligent German merchant in Vera Cruz one day to explain to me how it had come about that Germany had absorbed so much of the trade that at one time went to England. He reached into a drawer, pulled out an invoice from England and said, 'Do you see those denominations of yards, feet and inches, gallons and pints; pounds, two kinds of ounces, grains, and pennyweights, the whole summed up in pounds, shillings, and pence? Well,' he continued, 'a Mexican, even if he can read a little English, needs an interpreter and an accountant to put this into the language of civilization. And,' he added, 'their business methods generally are just as antiquated as their methods of computation. That is why we get the business, and then we make, not what suits us, but what the trade wants.'

"I wish the recital of this little incident could make the impression on you that it did on me. If it did, you would petition the President to make an order requiring government business to be transacted on the metric system—after 6 months such an order would accomplish the change. We should be in accord not only with Latin America, but all the rest of civilization, except England.

"The American manufacturer and merchant must learn to understand that a foreign market is always a 'buyers' market.' They have been accustomed to dealing in a seller's market here at home so long that it is hard for them to learn that lesson. England used to have virtually a monopoly of modern industry. She still roosts on that memory; she still thinks the world has to come to her. That is why she is being distanced in the commercial race."

Among the national legislators and officials who have expressed themselves in favor of the world metric standards are such men as Arthur Capper, Theodore Roosevelt, Julius Kahn, Admiral W. S. Benson, A. D. Lasker, John Barton Payne, W. C. Redfield, E. T. Meredith, Henry Van Dyke, Franklin D. Roosevelt, Elihu Root, Champ Clark, Fiorello H. La Guardia, and many others whose statements will be found in this book.

A few of the other officials who urge the metric advance are:

D. E. Beardsley, mayor, Dickson, Tenn.
F. N. Burrows, mayor, Bathgate, N. Dak.
John F. Dudgeon, mayor, Norfolk, Nebr.
Fred E. Eldredge, mayor, Panguitch, Utah.
J. W. Ferle, mayor, Lansing, Mich.
W. F. Freeman, mayor, Ardmore, Okla.
Eugene Gallaway, mayor, Coleman, Ga.
Samuel M. Hastings, mayor, Highland Park, Ill.
J. J. Keegan, mayor, city of Globe, Ariz.
Frank G. McPherson, mayor, Beaver Falls, Pa.
Charles Morieux, mayor, city of Calais, France.
J. F. Osborne, mayor, Joplin, Mo.
D. F. Powell, mayor, Walla Walla, Wash.
John R. Schisler, mayor, Winthrop, Minn.
William Sillboe, Turtle Lake, N. Dak.
Perry D. Thompson, mayor, Lowell, Mass.
H. S. Vincent, mayor, Deadwood, S. Dak.
James H. Williams, mayor, Middleport, Ohio.
S. T. Carson, mayor, Bethel, N. C.
D. F. Dunkle, mayor, West Palm Beach, Fla.
B. F. Genther, mayor, Brookneal, Va.
W. D. Johnson, mayor, Milford Center, Ohio.
F. C. Jones, mayor, Lewis, Iowa.
James Rolph, jr., mayor, San Francisco, Calif.
W. W. Seymour, mayor, Tacoma, Wash.
R. E. Stalcrys, mayor, Dalhart, Tex.
Al C. Anderson, State legislator, Wisconsin.
James Allan, State legislator, Nebraska.
Henry O. Andrew, State legislator, Boulder, Colo.
W. A. Ashbrook, State legislator, Ohio.
Stephen J. Benner, State legislator, Ohio.
Charles P. Caldwell, State legislator, New York.
W. H. Chrisman, State legislator, New Mexico.
J. M. Crawford, State legislator, Dundee, Oreg.
B. G. Crisp, State legislator, North Carolina.
Emma F. A. Drake, State legislator, New Plymouth, Idaho.
C. R. Evans, State legislator, Nevada.
Edward D. Helfrich, State legislator, Galion, Ohio.
Charles A. Maxwell, for county commissioners, Cumberland County, Md.
William Mellen, State legislator, Cripple Creek, Colo.
Oscar A. Naplin, State legislator, Thief River Falls, Minn.
Walter M. Pierce, State legislator, La Grande, Oreg.
A. J. Pullen, State legislator, Madison, Wis.
Maurice P. Rice, State legislator, Lewistown, Ill.
Julius A. Schmahl, secretary of State, St. Paul, Minn.
James A. Wenstrom, State legislator, Dover, N. Dak.
Charles S. Andrus, chairman, Industrial Commission of Illinois, Chicago.

Elias M. Ataviado, provincial secretary-treasurer, Densalan, Philippine Islands.

Andrew Baumert, jr., chairman, commission of State institutions, Phoenix, Ariz.

E. F. Benson, commissioner of agriculture, Olympia, Wash.

Jose Bermejo, bureau of customs, Manila, P. I.

Borough council, Shickshinny, Pa.

C. A. Briggs, Bureau of Standards, Washington, D. C.

H. D. Brown, Chief, United States Bureau of Efficiency, Washington, D. C.

Bureau of standards, State of Oklahoma, Norman, Okla.

John C. Ferguson, adviser to the President of China, Peking, China.

Charles M. Fuller, sealer of weights and measures, Los Angeles County, Calif.

W. W. Gilroy, deputy commissioner of labor statistics, State of Wyoming, Cheyenne, Wyo.

W. A. Graham, commissioner of agricultulre, State of North Carolina, Raleigh, N. C.

Joseph J. Hallowell, commissioner, mayor's bureau of weights and measures, New York City.

Jess C. Hover, city clerk, Binghamton, N. Y.

Barton Mansfield, insurance commissioner, State of Connecticut.

Lieut.-Col. C. J. Marshall, secretary, State Department of Agriculture, Harrisburg, Pa.

Jewell Mayes, secretary, State Board of Agriculture, Jefferson City, Mo.

H. J. Patterson, D. Sc., Maryland Agricultural Experiment Station, College Park, Md.

James J. Rafferty, director, Bureau of Commerce and Industry, Manila, Philippine Islands.

Nicholas Ricciardi, district vocational officer, Federal Board of Vocational Education, San Francisco, Calif.

J. H. Roberts, formerly superintendent U. S. Employment Service, Charleston, S. C.

H. D. Sammis, secretary, public service commission, Carson City, Nev.

R. J. Stegall, clerk, county court of Fayette County, Fayetteville, W. Va.

David O. Thomas, county superintendent of highways, St. Clair County, Belleville, Ill.

Theodore Townsend, secretary, State board of accountancy, Milford, Del.

Fred H. Waechter, secretary, borough of West Hazelton, Pa.

Robert D. Wall, State veterinarian, Des Moines, Ia.

Wesley Webb, secretary, State board of agriculture, Dover, Del.

William C. Wells, chief statistician, Pan-American Union.

Dr. C. L. Woods, U. S. Indian service, Valentine, Ariz.

P. L. Wormeley, U. S. Department of Commerce, Washington, D. C.

The weights and measures officials of the United States, in conference assembled at Washington, D. C., have indorsed the metric advance; and they have denounced statements of the antimetric propagandists as "false, malicious and untrue."

TYPICAL WORLD OPINION ON METRIC STANDARDIZATION.

J. Joffre, marshal of France (April 23, 1920): "I very highly approve the initiative shown in trying to get the metric system adopted in English-speaking countries. It is certain that the smplification that would be brought to your system of weights and measures would be of great service from a scientific and commercial point of view. It would also be useful from the viewpoint of military terminology."

Henri Petain, marshal of France (April 22, 1920): "I am confident that the adoption of the metric units will greatly facilitate the development of greater economic relations between allied countries."

R. Nivelle, general in the French army (December 22, 1920): "I had the honor of replying to the same question which has just been asked me (as to the advantages of adopting the metric system) when I was commanding the armies at Verdun. There is not a doubt that standard and unified measures would materially facilitate relations between the different nations. The metric system—the most modern and scientific system by far—will prove itself more and more necessary as international relations become more general and more

clearly defined. It is hardly necessary to take into consideration the small question of national pride, which is or so little moment between allies such as the two great republics of America and of France, which for three centuries have been bound by ties of friendship which nothing has ever weakened or will ever break."

Raymond Poincare, premier of France; former president of France: "M. Poincare is convinced of the great advantages that the metric system performs for the unification of measurements." (Afistide Briand, recent premier of France; and Marshal Ferdinand Foch are both cited elsewhere in this volume. Georges Clemenceau has also commended the world metric movement.)

M. Gourdaine, minister of labor, Republic of France (April 24, 1920): "The active campaign with a view to obtaining the adoption of the metric system of weights and measures throughout the world has all my support."

Armando Diaz, commander in chief, Italian forces in the World War (1922): "If the metric system were used universally, in like manner to an international language, it would certainly bring about a great simplification of commercial intercourse and in addition have a favorable influence in eventually removing the causes of strife among nations."

Alejandro M. Unsain, vice president of the Argentine Department of Labor; advisor, Argentine delegation, International Labor Conference (November 25, 1919): "The international metric system of weights and measures is the only legal system in Argent.na. Metric weights and measures are used exclusively. No other system is tolerated within the republic."

Dr. G. Pardo, delegate from Italy to the International Labor Conference, Washington, D. C., (November 25, 1919): "I sincerely hope that the United States Congress and the British Parliament will expedite legislation to secure for their respective countries the advantages of the general use of metric weights and measures. This would increase the efficiency of world labor and world trade, and would help the nations of the world to secure a common understanding."

Dr. Iwassaburo Nakahara, president of the Japan Electric Association (November 25, 1919): "The Japanese army has used the metric system exclusively for over half a century. An official commission consisting of representatives of the most prominent engineering societies of Japan recently made an extensive investigation with regard to the simplicity, adaptability and effectiveness of the metric system. It was unanimously decided that the international metric system would prove best for Japan."

"L'Independence Belge," Belgium (1921): "With all her supremacy in matters of industrial organization, the United States hesitates to adopt the metric system. Such argument (as is made by conservatives as excuse for retaining the cumbersome weights and measures) is astonishing coming as it does from men who have not been stopped by the greatest technical upheavals and who seem on the contrary to be most apt to adapt themselves to new things. But the fact remains, in this question of the metric system, and it is curious to note. It makes one think indeed that the people least attached to traditions—and who have also the fewest—still keep a certain fund of superstition, at least in certain domains. Can we be astonished then at the resistance of other peoples against certain progress whose value is obvious?"

The rapid trend toward metric standardization everywhere is indicated by excerpts from the world press:

Japan: "The metric bill, proclaimed by the Emperor on April 12, 1921, stipulates that within the period of three to five years the metric system be adopted by government offices, government works, most of the leading factories, technical schools and others. The period of 20 years to come is, however, allowed for the adoption by the general public, after which the use of the metric system will be made compulsory. The reform is a marked step toward internationalization of Japan's economic structure, and ranks in importance with the adoption of the Gregorian calendar at the beginning of the Meiji era. * * * Dr. Imaidzumi, of the House committee on the bill, when he reported it to the House of Representatives on March 25 emphasized his belief that the metric system will in no distant future be adopted by America and Great Britain, the tendency toward which can be gaged by the recent resolution adopted by the League of Nations to recognize the metric system agreement made at Paris in 1876." (In American Machinist, November 10, 1921.)

Russia: "An executive order directs that the metric system be officially used on and after January 1, 1922." (Special despatch to New York World, October 12, 1920.) "It is reported that the Russian Government has decided to introduce the metric system in August, 1921, and to prohibit the use of the old system of weights and measures from January 1, 1925." (Handbook of Siberia and Arctic Russia," p. 368; published by the British Admiralty.) "According to a decree of the people's commissars published in official soviet papers, the metric system of measure was to be introduced in all soviet institutions beginning with January, 1922, and from 1924 the metric system of weights and measures must be finally and universally adopted throughout Soviet Russia." (In New York Commercial, January 9, 1922.)

Netherlands and colonies: "Progressive firms the world over who are doing an international business are agitating for a system of standardized and efficient weights and measures. The varied systems now in use are not only cumbersome, inefficient and troublesome, but conspicuous for the lack of logic displayed. The clerk hire, the misunderstandings and mistakes incurred in coverting piculs to tons, liters to quarts, gallons and bushels, inches and feet to meters, etc., is useless, unnecessary and ridiculous. On the surface this may not appear to be of much serious consequence, but any one who has attempted to harmonize the finer measurements of nuts, bolts, screw threads and machine parts under the present system will soon realize the seriousness and inconvenience of our lack of international standards.

"The decimal coinage system has long since proved its superiority over the cumbersome pound, shilling and pence method which is so burdensome to countries doing business with England, but this is not nearly as ridiculous as some of the weights and measures which could be far more easily coverted to the simple and sane metric system. International business, as it flows along in a steady stream, as a great river in a well defined course, is not easily changed or dammed long enough to make even the slightest change. However, the ideal of standardization is not an idle dream, but a real possibility once the conservatives can be overthrown by the farther sighted, progressive, public-spirited trader.

"Before much can be done to establish an international harmony in our weights and measurement systems, a wreat deal of ground must be covered towards the standardization of local systems in various countries. The United States can boast of at least a score of varieties of bushels. China of a good collection of different dollars and cents, the East of a various assortment of piculs, etc.

"Undoubtedly there are a great many difficulties to be encountered before even the most minor changes along this line can be realized, but the fact remains that the world is thinking in international terms as it never has before. Narrow provincialism is giving way to the broader world vision and the countries of the world are sincerely striving to get on a better basis of understanding as never before. Perhaps the time is far distant when a universal language will be in common business use throughout the world and the idea of an international monetary standard may be an idle dream, but a common standard of weights and measures for the business world is not only practical, efficient and logical, but a possibility. With all of our modern efforts towards speed and efficiency it is rather a travesty on the common sense of the business world to be still clinging to the present motley assortment of systems for weights and measures." (From The Dutch East Indian Archipelago, Buitenzorg, Java; quoted in Pacific Ports, September, 1921.)

Poland: "The meter has been introduced as a unit of measure in all Poland, and the use of other measures is now prohibited." (In Algemeen Handelsblad, Amsterdam, Netherlands, October 28, 1919.)

Latvia: "The Latvian Government has passed a law introducing the metric system, but the old Russian system of weights and measures may be used, where necessary, until January 1, 1926." (In Commerce Reports, United States Department of Commerce, February 19, 1920.)

Greece: "The Government Gazette published a new law passed by the Chamber of Deputies which makes the metric system the official system of measurement throughout Greece." (In World Correspondence, New York Evening Post, November 18, 1920.)

These excerpts will give some indication of the trend of world opinion toward world metric standization. Since virtually all nations have already advanced to the decimal metric standards, naturally it would not be difficult to fill thousands of volumes with testimony from them as to the practical utility

of these units. Enough has been presented, however, to show the unanimity of the world on this point.

The present chapter has been devoted mainly to an exposition of the nation-wide support of the metric movement throughout the United States of America. The opinions of thousands of influential individuals have been cited, representative of every group and interest in our population. In view of all this, can it be denied that fully 99 per cent of all who have considered this subject are in favor of the metric system?

Surely, a comprehensive answer has been given to the question, "Who urges meter-liter-gram?"

The CHAIRMAN. These hearings will now be closed.

(Whereupon the hearings upon S. 2267 were closed, and the subcommittee adjourned.)

3 6105 029 332 181